

GENERATOR
PREPURCHASE SPECIFICATION
FOR
OFFICE FOR EMERGENCY MANAGEMENT
7 WORLD TRADE CENTER
NEW YORK, NY

ENGINEER
COSENTINI ASSOCIATES LLP
TWO PENNSYLVANIA PLAZA
NEW YORK, NY 10121

MARCH 20, 1998

PPS-Generators

Table of Contents

Bid Form	PPS-1
Basic Materials, Methods and Requirements	PPS-2
Products	PPS-8 to PPS-48
Emergency Generator Switchgear Schedule	PPS-49
ATS Schedule (1 Page)	PPS-50

OEM
7 WTC

PPS-i

Generators
March 20, 1998

PPS-Generators

Bid Form

1. Price for three (3) 500 KW emergency generator sets
generator power and control switchgear and nine (9)
automatic transfer switches \$ _____
2. Price for Graphic Annunciator \$ _____
3. Alternate price for 1 above for three (3) 750 KW emergency
generator sets in lieu of (3) 500 KW emergency generator
sets \$ _____
4. Price for 275 gallon day tank per specs \$ _____
5. Voluntary Alternates (by Bidders) \$ _____
\$ _____
\$ _____
\$ _____

OEM
7 WTC

PPS-1

Generators
March 20, 1998

PPS-Generators

BASIC ELECTRICAL MATERIALS, METHODS AND REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

- A. Comply with General Conditions and Division One.
- B. Basic Electrical Materials, Methods and Requirements applies to all sections of Division 16.
- C. Codes, Permits and Inspections:
 - 1. All work shall meet or exceed the latest requirements of New York City Building Code, New York City Electrical Code, P.A. Standards and all national, state, county, municipal, and other authorities exercising jurisdiction over electrical construction work and the project.
 - 2. All required permits and inspection certificates shall be obtained, paid for, and made available at the completion of the work. In the event that no official authority exists which will issue a certificate attesting to the safety of the electrical installations, such a certificate shall be acquired from an independent agency selected by the Architect. Inspection and certification fees levied by this agency shall be paid for as part of the electric work.
 - 3. Any portion of the work which is not subject to the requirements of an electric code published by a specific authority having jurisdiction shall be governed by the National Electrical Code and other applicable sections of the National Fire Code, as published by the National Fire Protection Association.
 - 4. Equipment, material, layout and installation provided as part of the electrical work shall conform to the requirements of all agencies having jurisdiction. Include as part of the electrical work all required filings and submissions for approval. Equipment furnished separate from - but installed as part of - the electrical work, which does not have all necessary approvals, shall not be installed until approvals are obtained by the parties furnishing the equipment.

OEM
7 WTC

PPS-2

Generators
March 20, 1998

PPS-Generators

D. Guarantees and Certifications

1. All work shall be guaranteed to be free from defects. Any defective materials or workmanship as well as damage to the work of all trades resulting from same shall be replaced or repaired as directed for the duration of stipulated guaranteed periods.
2. The duration of guarantee periods following the date of beneficial use of the system shall be one year. Beneficial use is defined as operation of the system to obtain its intended use.
3. The date of acceptance shall be the date of the final payment for the work or the date of a formal notice of acceptance, whichever is earlier.
4. Certification shall be submitted attesting to the fact that specified performance criteria are met by all items of electrical equipment for which such certifications is required.

E. Definitions and Interpretations

1. As used in the drawings and specifications for electrical work, certain non-technical words shall be understood to have specific meanings as follows regardless of indications to the contrary in the General Conditions or other documents governing the electric work.

"Furnish" -- Purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the electrical work. Purchasing shall include payment of all sales taxes and other surcharges as may be required to assure that purchased items are free of all liens, claims or encumbrances.

"Install" -- Unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the electrical work.

"Provide" -- "Furnish" and "install."

"New" -- Manufactured within the past two years and never before used.

2. Regardless of their usage in codes or other industry standards, certain words as used in the drawings or specifications for the electrical work, shall be understood to have the specific meanings ascribed to them in the following list:-

OEM
7 WTC

PPS-3

Generators
March 20, 1998

PPS-Generators

"Circuitry" -- Any electric work (not limited to light and power distribution) which consists of wires, cables, raceways, and/or specialty wiring method assemblies taken all together complete with associated junction boxes, pull boxes, outlet boxes, joints, couplings, splices and connections except where limited to a lesser meaning by specific description.

"Wiring" -- Same as Circuitry.

"Circuit" -- Any specific run of circuitry.

3. Reference to "U.L. (Materials Construction) Standards" shall mean the "Standards for Safety," published by Underwriters Laboratories, Inc. (Main Office: 333 Pfingsten Road, Northbrook, Illinois 60062).
4. Reference to "NEMA Standards" shall mean the "Approved Standards" published by the National Electrical Manufacturers Association (Main Office: 2101 "L" Street, N.W., Washington, D.C. 20037).
5. Reference to "ANSI Standards" shall mean the standards published by the American National Standards Institute (Main Office: Twenty East Fortieth Street, New York, New York 10016).
6. Reference to "AEIC Specifications" shall mean the specifications published by the Association of Edison Illuminating Companies (Main Office: Fifty-one East Forty-second Street, New York, New York 10017).
7. Reference to "ASTM" specifications shall mean the specifications published by the American Society for Testing and Materials (Main Office: 1916 Race Street, Philadelphia, Pennsylvania 19103).
8. Items and installation methods as described in the drawings and specifications for electrical work are to be used only under normal electric work conditions as hereinafter described unless there are specific notations to the contrary.
9. Items and installation methods as described in the drawings and specifications for electrical work are to be used only at less than 600 volts unless there are specific notations to the contrary.

OEM
7 WTC

PPS-4

Generators
March 20, 1998

PPS-Generators

10. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any electrical item in the drawings and specifications for electrical work carries with it the instruction to furnish, install and connect the item as part of the electrical work regardless of whether or not this instruction is explicitly stated.
11. It shall be understood that the specifications and drawings are complementary and are to be taken together for a complete interpretation of the work. Where there are conflicts between the drawings and specifications or within the specifications or drawings themselves, the items of higher standard shall govern.
12. To the extent that they govern the basic work, the specifications also govern change order work if any.
13. No exclusion from or limitation in, the symbolism used on the drawings for electrical work or the language used in the specifications for electrical work shall be interpreted as a reason for omitting the appurtenances or accessories necessary to complete any required system or item of equipment.
14. The drawings for electrical work utilize symbols and schematic diagrams which have no dimensional significance. The work shall, therefore, be installed to fulfill the diagrammatic intent expressed on the electrical drawings, but in conformity with the dimensions indicated on the final working drawings, field layouts and shop drawings of all trades. In particular, information as to the exact size, location and electrical connection points for mechanical equipment shall be derived by reference to HVAC and Plumbing documents.
15. Certain details appear on the drawings for electrical work which are specific with regard to the dimensioning and positioning of the work. These are intended only for general information purposes. They do not obviate field coordination for individual items of the indicated work.
16. Information as to general construction and architectural general construction and architectural features and finishes shall be derived from structural and architectural drawings and specifications only.
17. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.
18. Ratings of devices, materials and equipment specified without reference to specific performance criteria shall be understood to be nominal or nameplate ratings established by means of industry standard procedures.

OEM
7 WTC

PPS-5

Generators
March 20, 1998

PPS-Generators

1.02 QUALITY ASSURANCE

A. Products Criteria

1. All equipment furnished as part of the electrical work shall comply with the latest editions of all applicable state and municipal "energy codes". Provide certification from the equipment suppliers for all energy-consuming equipment that the equipment fully complies with these codes. Equipment submissions will not be accepted for review unless accompanied by such certification in writing.
2. All equipment and materials for permanent installation shall be the products of recognized manufacturers and shall be new.
3. New equipment and materials shall:-
 - a. Be Underwriters Laboratories, Inc. (U.L.) labeled and/or listed where specifically called for, or where normally subject to such U.L. labeling and/or listing services.
 - b. Be without blemish or defect.
 - c. Not be used for temporary light and power purposes without Architect's authorization.
 - d. Be in accordance with the latest applicable NEMA standards.
 - e. Be products which will meet with the acceptance of the agency inspecting the electrical work. Where such acceptance is contingent upon having the products examined, tested and certified by U.L. or other recognized testing laboratory, the product shall be so examined, tested and certified.
4. Except for conduit, conduit fittings, outlet boxes, wire and cable, all items of equipment or material of one generic type shall be the product of one manufacturer throughout.
5. It is the intent of these specifications that wherever a manufacturer of a product is specified, and the terms "other approved" or "or approved equal" or "equal" are used, the substituted item must conform in all respects to the specified item. Consideration will not be given to claims that the substituted item meets the performance requirements with lesser construction. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance.

OEM
7 WTC

PPS-6

Generators
March 20, 1998

PPS-Generators

6. Substituted equipment or optional equipment where permitted and approved, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether approved or not, shall be replaced at the Contractor's expense. Any modifications of related systems as a result of substitutions shall be made at the Contractor's expense.
 7. Note that the approval of shop drawings, or other information submitted in accordance with the requirements hereinbefore specified, does not assure that the Engineer, Architect, or any other Owner's Representative, attests to the dimensional accuracy or dimensional suitability of the material or equipment involved or the ability of the material or equipment involved or the mechanical performance of equipment. Approval of Shop Drawings does not invalidate the plans and specifications if in conflict, unless a letter requesting such change is submitted and approved on the Engineer's letterhead.
 8. Substitutions of Electrical Equipment for that shown on the schedules or designated by model number in the specifications will not be considered if the item is not a regular cataloged item shown in the current catalog of the manufacturer.
- B. Manufacturer's Recommendations: Where installation procedures of any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

1.03 MAINTENANCE DATA AND OPERATING INSTRUCTIONS:

- A. After all final tests and adjustments have been completed, fully instruct the proper Owner's Representative in all details of operation for equipment installed. Supply qualified personnel to operate equipment for sufficient length of time to assure that Owner's Representative is properly qualified to take over operation and maintenance procedures. Supply qualified personnel to operate equipment for sufficient length of time as required to meet all governing authorities in operation and performance tests.
- B. Furnish eight (8) manuals, in bound form containing data covering capacities, maintenance of operation of all equipment and apparatus. Operating instruction shall cover all phases of control and include the following:
 1. Performance Curves: All relevant data for each item of equipment including complete short circuit analysis and coordination study.

OEM
7 WTC

PPS-7

Generators
March 20, 1998

PPS-Generators

2. Lubrication Schedule: Indicating type and frequency of lubrication required.
 3. List of Spare Parts: Recommended for normal service requirements.
 4. Parts List: Identifying the various parts of the equipment for repair and replacement purposes.
 5. Instruction Books may be standard booklets but shall be clearly marked to indicate applicable equipment.
 6. Wiring Diagrams: Generalized diagrams are not acceptable, submittal shall be specifically prepared for this Project.
 7. Automatic Controls: Diagrams and functional descriptions.
- C. Where applicable, one set of operating and maintenance instructions shall be neatly framed behind glass and hung adjacent to the equipment concerned.

PART 2 - PRODUCTS

2.01 WORK INCLUDED

- A. Emergency Generator Sets.
- B. Radiator mounted load banks, control panels.
- C. Generator power and control switchgear.
- D. Automatic transfer switches.

2.02 RELATED WORK

- A. Section 15000 - Fuel Oil Tank and Piping
- B. Section 15000 - Acoustical Treatment, Dampers, Operators.

2.03 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code
- B. ANSI/NEMA MG-1 - Motors and Generators.

OEM
7 WTC

PPS-8

Generators
March 20, 1998

PPS-Generators

- C. ANSI/NEMA 250 - Enclosures for Electrical Equipment.
- D. ANSI/IEEE 446 - Emergency and Standby Power Systems.
- E. NYC Electrical Code

2.04 QUALITY ASSURANCE

- A. In order to define requirements for quality and function, product specifications designate manufacturers.

2.05 SUBMITTALS

- A. Submit product data.
- B. Submit short circuit and coordination study.
- C. Submit product data, list of materials, service location.
- D. Submit alternate price quotations.

2.06 EMERGENCY ELECTRIC GENERATING SETS

- A. Emergency electric generating sets shall be automatic starting diesel single engine driven, shall have nominal electric characteristics of 480/277 volts, 3 phase, 4 wire, 60 cycles and shall each be able to supply its indicated load at power factors down to 80%. The sets shall be suitable for operation, in conjunction with the generator control switchgear as an automatically started and paralleled plant.
- B. The emergency generator sets and all their associated controls and appurtenances shall be suitable for use where the load to be supplied consists of non-linear loads such as solid state transistorized or SCR drives or UPS systems supplying computers and variable speed motor drives. Submit manufacturer's certification thereto.
- C. Submit manufacturers certification that, with supply facilities provided and ambient conditions maintained as hereinafter specified, the engine generator sets, in conjunction with the generator control switchgear, are capable of meeting the following performance criteria:-

OEM
7 WTC

PPS-9

Generators
March 20, 1998

PPS-Generators

1. In response to a "cranking" signal from the generator control switchgear, all engine generator sets shall be automatically started, synchronized and paralleled, and shall pick up and divide all "first priority" loads in stages within 10 seconds. All second priority loads shall be picked up in stages within 15 seconds.
2. Load handling capability to be such as to permit the specified load to be carried for 350 consecutive hours without trouble or damage.
3. Each generator shall be designed to carry its load with a full load temperature rise, as measured by resistance, of not more than 80° over a 40°C ambient temperature. Limitations on the maximum allowable sub-transient reactance as specified herein may result in a full load temperature rise less than 80°C. The generator shall have a sub-transient reactance of less than 12% (at its specified full load rating) as derived by re-rating the reactance down from the sub-transient reactance based on the generator 130°C KW rating.
4. Speed governor operation such that at any fixed operating temperature variation from any manually selected speed shall be zero for any steady state load from no load up to specified load conditions.
5. Voltage regulation to be such as to permit a setting of the manual voltage adjustment device hereinafter specified which will maintain the output voltage within a range of plus or minus 1/2% of nominal for any steady state load from on load up to the specified load conditions.
6. Stable operation to be such that for any particular steady state load (between no load and the specified load conditions) the steady state frequency deviation shall not exceed $\pm 1/4\%$.
7. Stable operation to be such that for any particular steady state load (between no load and the specified load conditions) the steady state voltage deviation shall not exceed $\pm 1/2\%$.
8. Surge handling capability to be such as to permit a one step application of a load whose "KW" is 100% of the specified generator set rating, without casing the engine to stall.
9. Voltage transient deviation shall be 20 percent maximum from rated generator terminal voltage on one step application or removal of full load when generator is driven by diesel engine.

OEM
7 WTC

PPS-10

Generators
March 20, 1998

PPS-Generators

10. Frequency transient deviation shall be 12 percent maximum deviation from rated generator terminal frequency on one step application or full load at either 0.8 or 1.0 power factor when generator is driven by diesel engine.
 11. Voltage and frequency transient recovery time shall be 10 seconds maximum for one step application or removal of full load at either 0.8 or 1.0 power factor from the time the generator terminal voltage and frequency leaves the respective regulation limits, to the time the generator terminal voltage and frequency recovers within respective regulation limits when generator is driven by diesel engine.
- D. Submit sufficient data regarding emissions of contaminants, noise levels and other pertinent data, as required to demonstrate compliance with all applicable criteria, regarding environmental pollution, of the State Department of Environmental Conservation and all agencies having jurisdiction.
- E. The engine of each generating set shall be supplied with all appurtenances necessary for operation including the following:-
1. Integrally factory mounted oil pump and other equipment and appurtenances as required, for a self-contained replaceable filter, full pressure type, lubricating oil system.
 2. Integrally factory mounted battery, relays, electric cranking motor, battery charging generator, and other equipment and appurtenances as required for self-contained automatic electric starting in response to the closing of a contact in a two wire control circuit extension from the generator set (external cranking circuit). If the battery cannot be factory mounted on the base, it shall be provided complete with floor mounted battery rack of size and type suitable for the space conditions within the generator room. Include all required field wiring. The battery shall be of adequate capacity to provide for 60 seconds of continuous cranking with an ambient room temperature of 32°F.
 3. Integrally mounted engine driven fuel pump complete with prefilter ahead of the pump and standard filter after the pump. The pump shall be sized so as to be compatible with the fueling system. Include water separator system.
 4. Integrally mounted, electric motor driven, air-cooled fuel oil cooler, complete with electric supply tapped from generator control panel. Radiator cooled unit will not be acceptable unless manufacturer certifies that radiator has been sized to accommodate this additional load. Cooler shall limit maximum engine fuel inlet temperature to 130°F with engine running continuously at full load.

OEM
7 WTC

PPS-11

Generators
March 20, 1998

PPS-Generators

5. Controls which initiate up to 30 seconds of cranking in response to signals from automatic transfer switch cranking contacts, and then lock out to prevent further cranking (until manually reset) in the event the engine has failed to start. Also include switching provisions at the generator control switchgear to permit testing of the cranking sequence by simulating voltage failure. Also include "Emergency Generator Manual Start" switching provisions, located where directed, together with 2 #14 runs (in raceway) to the engine control panel, and connected so as to enable manual generator start-up by simulating voltage failure.
6. Controls which cause generator shutdown after normal source voltage on all phases of all services has been restored (to at least 90% of the average maintained normal value) for an adjustable period of from 1 to 30 minutes.
7. Modifications necessary for operation with No. 2 fuel oil.
8. Automatic float type battery charger. Charger shall be AC line compensated and current limited with fused input and output, and with complete isolation between input and output. It shall be complete with DC ammeter and voltmeter and combination high/low battery voltage alarm contact. Minimum charging rate shall be 10 amps at 24VDC.
9. Integrally factory-mounted lube oil pressure and jacket water temperature gauges and running time meter, together with sensors and other devices necessary for the complete and proper inspection, surveillance during operation, care and maintenance of engine. Sensors shall be as required to provide "pre-alarm" and "alarm" warnings as called for in the annunciator panel described hereinafter, and shall each be wired to readily accessible terminals on the engine.
10. An annunciator panel of the manual reset type, installed, in the generator control switchgear, to signal audibly, and to identify visually, any of the "pre-alarm" or "actual alarm" conditions described hereinafter, as well as an engine shutdown device to operate in response to any of the "actual alarm" conditions. The annunciator shall be complete with silencing switch and "alarm silenced" pilot light, and master relay with N.O. and N.C. contact for signaling engine shutdown to external alarm system and shall indicate the following:-
 - a. Low jacket water temperature -- pre-alarm.
 - b. High jacket water temperature -- pre-alarm.
 - c. Low lube oil pressure -- pre alarm.

OEM
7 WTC

PPS-12

Generators
March 20, 1998

PPS-Generators

- d. Overcrank (engine failed to start) – actual alarm.
 - e. Over-speed – actual alarm.
 - f. High jacket water temperature – actual alarm.
 - g. Low lube oil pressure – actual alarm.
11. An individually enclosed, D.C. operated annunciator panel which duplicates the annunciators provided at the generator control switchgear. The panel shall be mounted, on the 23rd floor in the Mechanical Room at a location where directed, and the required circuitry connection to the generator switchgear, as well as a voltage supply connection to the engine starting battery, shall be provided. The panel shall also include a silencing switch and "alarm silenced" pilot light.
 12. Electronic "load sharing type" speed governor incorporating all features necessary for manual and automatic synchronizing and paralleling of the engine-generator set with other sets. The control section of the governor shall be installed in the generator control switchgear.
 13. Provide alternate price for 275 gallon diesel fuel ready supply "day-tank" complete with five 2 pole float switches for 5 amps at 600 volts minimum duty and suitable connections to permit the attachment of fill, overflow return and vent piping which will be separate from the electric work. Day tank shall be U.L. labeled, and the vessel (together with electrical and fuel connections thereto) shall be suitable for operation at a working pressure of 5 psig. If the day tank is not factory installed, field installation of the day tank on, or adjacent to, the engine base will be acceptable, however, any appurtenances such as solenoid valves, etc., and connections between day tank and engine shall be provided as part of the electric work. Float switches shall be arranged for "low alarm," "level control/lead pump", "level control/lag pump," "high alarm," and high level safety cut out" operation. Include a power supply connection from the nearest adequate 120 volt emergency source as well as circuitry extensions to solenoid valves, pump motors, etc., as required for control of fuel supply. Provide integrally mounted day tank overflow pan sized for twice the capacity of the day tank, and complete with 2-pole (alarm plus pump shutdown) float switch. Include 2-wire circuitry extension to fuel transfer tank pump, arranged to shut down transfer pump on overflow of day tank.

OEM
7 WTC

PPS-13

Generators
March 20, 1998

PPS-Generators

14. The engines may be supplied from a day tank system furnished and installed by the mechanical trade, complete with pump, overflow pan, float switches and piping to the engine solenoid valves. Provide on each engine a factory mounted 10 gallon priming tank, complete with solenoid valve on upstream side of tank, and piping from tank to the engine driven fuel pumps. Include power supply connections, and circuitry extensions to all pump motors (at day tank and at remote storage tank), float switches, solenoid valve, etc. as required for complete control of fuel supply.
 15. "Critical" type muffler, thimble for exhaust pipe "through building" connection, and flexible exhaust pipe section for incorporation into the required exhaust pipe system which will be installed separate from the electric work. Muffler shall be sized so that the engine will be capable of delivering its rated output with a friction head back pressure of up to 3/4" of mercury in the exhaust pipe extension from the output side of the muffler (i.e., excluding the drop in the muffler).
 16. Air box drain collectors, interconnecting piping and central collector if required, to insure no spillage of fuel oil during periods when the engine is running lightly loaded or unloaded.
 17. Integrally factory-mounted radiator, forward blowing fan (blow through radiator from engine side), engine jacket water pump, thermostatic water flow control, and all other equipment and appurtenances as required for a self-contained water cooling system, including suitable collar at radiator for duct connection which will be separate from the electric work. Any required intercooling or aftercooling shall be derived from the aforementioned radiator or from an additional integrally mounted radiator stage. Fan shall be capable of overcoming 1" external static in addition to radiator and load bank.
 18. Integrally factory mounted and wired engine block heater with thermostat and "engine running" cut out contact to maintain jacket water temperature at least 100°F when engine is not running and ambient temperature of room is maintained at not less than 50°F. Incorporate contactor-if required-and disconnect switch. Heater shall be suitable for operation from a separate 50 amp, 120/208 volt, 3 phase, 4 wire electric supply.
- F. The generator of each generator set, together with its associated voltage regulator, exciter, control switches, instrumentation and controls shall be of a type which is suitable for applications where the load to be supplied consists of substantial amounts of non-linear (i.e., harmonic producing) equipment. To minimize the effect of the harmonics on the generator voltage wave shape, incorporate the following features and functions:
1. The stator winding shall be of a 2/3 pitch design and shall be random wound.

OEM
7 WTC

PPS-14

Generators
March 20, 1998

PPS-Generators

2. The voltage regulator shall incorporate 3-phase true RMS sensing specifically designed for the application.
 3. The excitation system for the voltage regulator shall utilize a permanent magnet generator, except that a self-excitation system may be utilized where the voltage regulator is of a type specifically intended for non-linear load applications. Such regulator shall not incorporate any SCR's in its circuitry, and it shall be complete with isolation transformers and filtering as noted below.
 4. Isolation transformers complete with filtering equipment, shall be provided to minimize the effect of distortion on the voltage regulator power supply and sensing circuits, on governor control and supply circuits, on instrumentation and relaying and on other voltage sensing components.
 5. Voltage and current sensing devices shall sense true RMS values, and frequency sensing devices shall sense zero crossover.
- G. The generator of each generating set shall be equipped with amortisseur windings and other features necessary for parallel operation with other generator sets, and shall be supplied with all appurtenances necessary for operation including the following:-
1. Integrally factory mounted exciter and all other appurtenances necessary for self-contained excitation.
 2. Voltage regulator incorporating all features necessary to permit synchronizing and parallel operation of the generating set with other sets. The voltage regulator shall be installed in the generator control switchgear, and shall include provision for manual adjustment.
- H. Each emergency generating set shall be arranged to operate as certified and coordinate with conditions and facilities established on the basis of the following assumptions:-

Weight of End Unit-----15,000 lbs.
(Ready to Run)

Overall Length of Unit-----15'-0"

Overall Width of Unit-----6'-0"

Overall Height of Unit-----10'-0"

Height of Unit Above Sea Level----Within 1,000 Ft.

OEM
7 WTC

PPS-15

Generators
March 20, 1998

PPS-Generators

Ambient Temperature In-----110°
Generator Housing With
Machine Running.

Fuel Rating-----19,250 BTU/Lb

Fuel Consumption Per Kilowatt-----0.7 Lbs./Hr. (0.1 Of Certified Load (GPH)

Combustion Air Intake Per -----5.0 CFM.
Kilowatt of Certified Load

Exhaust Gas Flow Per -----15.0 CFM.
Kilowatt of Certified Load

Maximum Friction Head Back -----3/4 Inch Mercury.
Pressure Permissible in
Exhaust Pipe Extension
(Excluding Muffler)

Temperature of Exhaust Gasses -----1200°F.

Static Pressure In -----One (1) Inch Water
Air Stream Leaving
Load Bank

Air Flow Through -----100 CFM
Radiator Per Kilowatt
Of Certified Load

- I. Each engine and generator set shall be "factory package" mounted on a rigid base consisting of a full length skid or rail of structural steel on each side and cross bracing members at each end. Stable spring mountings incorporating a minimum static deflection of 2" shall be provided between the dunnage steel and the base to which the engine and generator are fastened. The spring mountings shall incorporate neoprene acoustical pads and leveling adjustments.
- J. Include the mounting of generator breakers and battery chargers and all connections between same and the generating sets as set forth in manufacturer's wiring diagrams and instructions. Include power supply connections to block heaters and battery chargers. If the battery is not factory installed, include the field installation of battery, battery rack(s) and interconnecting cables.

OEM
7 WTC

PPS-16

Generators
March 20, 1998

PPS-Generators

- K. Provide an integrally mounted automatic circuit breaker located as near as possible to the generator output terminals and connected to the generator. Circuit breaker shall be sized at 100% of output current rating of the generator.
- L. In conjunction with the generator set, provide a multipole "break glass" switch, located outside of room, and 2 #14 runs in rigid galvanized conduit to the engine control panel and day tank float switch. Connect so as to provide emergency shutdown of generator set and fuel transfer pumping system.
- M. Except for the required field installation, and connections, the generating sets, load bank and control switchgear shall be presented at the project as a "single source" item for which responsible "one party" overall maintenance (spare parts and service) is available.
- N. In conjunction with each generating set, 15 amp fused, single phase, 2 #12 wires in conduit automatic louver damper connections shall be tapped off the generator output line ahead of the line protective device in the control panel. One such connection shall be included for each electrically operated automatic louver damper provided for the generating set separate from the electric work in ventilating openings for the room housing the set. The connections shall be without switches or any other controls and shall be such that the louver dampers open directly in response to the appearance of the voltage at the output of the generator.
- O. Generating sets shall be as manufactured by Cummins, Caterpillar, General Motors/Detroit Diesel, Mitsubishi or other approved.
- P. Factory Test
 - 1. Each diesel engine-generator set, shall be tested at the factory to demonstrate compliance with the Specifications. Tests shall be witnessed by the Owner and/or his representative. A certified copy of this performance test shall be submitted before shipment to the job site, with a minimum of the following conditions met. Any defects which become evident during the test shall be corrected before continuing.
 - a. Each generator shall be capable of attaining rated voltage and frequency under no-load conditions, within five (5) seconds of the initiation of a start signal.
 - b. Each generator shall operate under full load conditions for a minimum of four (4) hours. The generator set shall maintain rated voltage ± 5 volts and rated frequency $\pm .5$ hertz for the duration of the full load test. Voltage, amperage and frequency measurements, as well as engine gauge and monitor points, shall be recorded at 15 minute intervals.

OEM
7 WTC

PPS-17

Generators
March 20, 1998

PPS-Generators

- c. Operate unit from 0 to 100 percent load, starting at no load and increasing in increments of 25 percent then decreasing from 100 to 0 percent load in 25 percent increments. Hold at each incremental load for 10 minutes and check at each load point for stable operation, fuel consumption, engine performance, and generator performance. Each generator set shall be capable of returning to its rated voltage and frequency within 5 seconds with a maximum voltage drop of 20% when incremental loads are added.
 - d. Operate each unit from 0 to 100 percent load, with the following increments: 0% to 50%, 50% to 0%, 25% to 75%, 75% to 25%, 0% to 100%, 100% to 0%. Hold at each incremental load for 10 minutes and check for stable operation. The generator set shall be capable of returning to its rated voltage and frequency within 5 seconds with a maximum voltage drop of 25% when full load is added.
 - e. Perform full load transient tests verifying that kilowatts, voltage, amperes, and frequency transient characteristics, are within acceptable limits. Submit 3 phase oscillograph tracings of all transient tests and of paralleling operation.
 - f. Check engine fuel system and water cooling system for possible leaks during the load test. If any fuel or water leaks are observed, the unit must be stopped and the leaking item shall be tightened or replaced as required, and the load test shall be restarted.
 - g. Deliberately speed up the engine by misadjusting the governor and record the speed at which the engine automatically shuts down.
 - h. Simulate low oil pressure by shorting the contacts of the oil pressure relay, to test for automatic engine shutdown on low oil pressure.
 - i. Simulate high water temperature by shorting the contacts of the water temperature relay to test for automatic engine shutdown on high water temperature.
 - j. The load bank used for this test shall be 50% resistive and 50% non-linear.
2. After successful test the unit shall be broken down into 3 major components (engine, generator, radiator) for shipment and installation at job site. The base shall be cut for delivering and welding together at site.

OEM
7 WTC

PPS-18

Generators
March 20, 1998

PPS-Generators

Q. Site Tests

1. Manufacturer shall provide the services of factory trained engineer and the technicians to conduct and supervise the installation and site tests.
2. Generator set supplier shall supervise reinstallation of components, align, inspect and re-certify each unit after installation. Any deficiency with the installation shall be brought to the attention of the contractor for repair or alteration. The unit shall be started up and run at No Load to determine that all systems are functional.
3. To demonstrate satisfactory operation of the generator sets each shall be automatically started, paralleled and run with the load of the resistive load bank system. Test shall continue to demonstrate shutdown and load shed sequences. The owner and engineer shall witness this test. The test shall be run a minimum of two (2) hours with as much on-site load as is available. Test reports shall be filled in during the test to record, as a minimum, voltage, amperage, frequency, oil pressure, water temperature and ambient temperature at 15 minute intervals. These reports shall be provided to the owner and engineer after the test for his approval.
4. In addition to the above running test, there should a functional test of any feature of the generator that may not have been installed properly or altered since the factory test. As an example, for the remote annunciator, each light on the panel should be tested to verify it works as installed. Submit a test plan to the engineer, prior to testing, which shows which tests are to be performed.

R. Operation and Maintenance Manuals

1. The bidder shall furnish six copies of operating and maintenance instructions and illustrated parts books covering the engine-generator and auxiliary equipment which will require operating instructions and periodic maintenance.

S. Commissioning

1. Furnish the services of a competent, factory-trained engineer or technician to be available at the job site for period of two days for initial start-up and for instruction personnel in operation and maintenance of the equipment, on the dates requested by the Owner.

OEM
7 WTC

PPS-19

Generators
March 20, 1998

PPS-Generators

T. Equipment Warranty

1. Equipment furnished under these Specifications shall be guaranteed against defective parts and workmanship under terms of the manufacturer's and dealer's standard warranty. But, in no event, shall it be for a period of less than two years from date of initial start-up of the system and the job site and shall include labor and travel time for necessary repairs at the job site.

Running hours shall not be a limiting factor for the system warranty. During the guarantee period, the manufacturer shall respond to the emergency within less than two hours. Two hour response shall be provided for two years around the clock.

2.07 LOAD BANK SYSTEM

- A. Provide on each generator a downstream radiator mounted indoor type air-cooled, resistive load bank. The load bank is to be used for periodic, scheduled, supervised maintenance exercise and testing of the standby/emergency power source and UPS equipment. Each load bank shall be operated by remote manual control.
- B. The system shall include a control panel that will control and monitor each bank remotely and shall include a distribution board as shown on the drawings.
- C. Load Bank Ratings shall be as follows:-
 1. Load Capacity: Indicated KW rating of generator at 1.0 power factor.
 2. Load steps shall be in 50 KW increments.
 3. Voltage: 480/277V AC, 3 phase, 4 wire.
 4. Frequency: 60 Hertz.
 5. Duty cycle: Continuous.
- D. Each load bank shall include all resistive load elements, load control devices, load element branch circuit fuse protection, main load bus and terminals, cooling system, unit controller and malfunction detection system and NEMA type I enclosure.
- E. Load elements: Open, helically wound, chromium alloy electrical resistance wire derated to operate at 60% of the maximum continuous temperature rating of wire. Element wire to be mechanically supported over entire length in such a way that should a wire break, the broken wire segments will not short to adjacent conductors or to ground.

OEM
7 WTC

PPS-20

Generators
March 20, 1998

PPS-Generators

1. Load elements are to be individually serviceable and replaceable from the front of the unit in the field without major disassembly of the load bank. An acceptable design to satisfy this requirement is the installation of the load elements in slide-out, removable trays in such a way that any element is easily accessed without disturbing any other elements.
 2. All materials used in the mounting and installation of the load elements shall be suitable for the temperature encountered, both in normal operation and under fault conditions.
 - a. Materials in direct contact with the element wire shall be ceramic. These ceramics shall be installed upon and reinforced and supported by stainless steel structures.
 - b. Other materials which structurally support the load elements and/or form from the hot air duct within which the elements are mounted shall be steel, stainless steel or aluminum.
 - c. Plastics and glass reinforced plastic materials and flammable materials are not acceptable materials of construction for installation, support and mounting of load elements or in the construction of the load bank hot air duct.
 3. Load elements shall be Simplex "Power Web" Brand or other approved.
- F. The resistive load shall be fused in branch circuits of not more than 50KW each.
1. Load circuit fuses shall be 200,000 A.I.C. current limiting type, extremely fast acting, 600V rated.
- G. Load control shall incorporate one magnetic contactor per each fused branch circuit.
- H. Load power wiring shall incorporate 150°C insulated.
- I. Main terminals shall incorporate copper, 1000A per square inch.
- J. Each load bank shall include a unit controller which provides the following functions:
1. Power supply for load bank control circuits.

OEM
7 WTC

PPS-21

Generators
March 20, 1998

PPS-Generators

2. Malfunction detection system consisting of sensors within the load bank, load bank enable/disable permissive circuit and alarms. Malfunction detection sensors to include: cooling air intake temperature switch set as recommended by manufacturer, exhaust air temperature switch set at no more than 40°F above the maximum rated temperature rise and an air pressure switch to sense for loss of cooling airflow.
3. Remote load dump circuit to trip load bank off-line from remote contacts. A manual bypass switch shall be provided to override the remote contacts.
4. Input/output devices and control circuits for operation of load bank from remote devices when in "automatic" mode or "remote" mode.
5. Auxiliary dry contacts for field use to indicate load bank "operating normally" and "load bank failure".
6. Manual control panel consist of:
 - a. Mode selector switch to select the following: "Off", "Manual", "Remote."
 - b. Manual "run", "stop" pushbuttons
 - c. Switch to bypass remote load dump contacts
 - d. Master load control switch
 - e. Load bank control switch; one for each load bank..
 - e. Load step control switches, one for each load step
7. Status annunciator with visual indicators for the following:-
 - a. Power connected to load bank
 - b. Load bank running in local-manual mode
 - c. Load bank running in remote mode
 - d. Remote load dump activated
 - e. Load dump bypassed
 - f. Load bank operating normally

OEM
7 WTC

PPS-22

Generators
March 20, 1998

PPS-Generators

- g. Load bank disabled due to cooling failure
 - h. Master load switch on
 - i. Load step on (one for each load step)
 - j. Individual load bank on-off.
 - k. Individual generator run-off.
- 8. Load bank shall include control circuitry with airflow switch to shut down load bank with no air flow and interlock with generator control switchgear to shut down load bank when generator is in cool down cycle.
 - 9. The load bank shall be a product of a firm regularly engaged in the design and manufacture of generator load banks.
 - 10. The load bank manufacturer shall demonstrate at least five years experience with at least twenty-five successful installations of load banks similar or equal to the load bank specified herein.
 - 11. The load bank for this application shall be by Simplex, Inc. 1139 N. MacArthur Blvd., Springfield, Illinois 62702, 800-637-8603 or other approved.
- K. Load bank remote control panel enclosure shall be NEMA type I wall mounting, with hinge-open front.
 - L. Terminal blocks shall be provided for connection.
 - M. The remote panel shall duplicate all control and monitoring functions of the local system controllers as specified hereinbefore.
 - N. Factory Test
 - 1. The load bank system shall be tested mounted on the generator at the factory to demonstrate compliance with Specifications. Tests shall be witnessed by the Owner and/or his representative. A certified copy of the performance test shall be submitted before shipment to the job site. Any defects which become evident during the test shall be corrected before continuing.

OEM
7 WTC

PPS-23

Generators
March 20, 1998

PPS-Generators

O. Site Tests

1. Manufacturer shall provide the services of factory trained engineer and the technicians to conduct and supervise site tests.
2. Supplier shall inspect the unit after installation. Any deficiency with the installation shall be brought to the attention of the contractor for repair or alteration. The unit shall be started up and run to determine that all systems are functional.

P. Operation and Maintenance Manuals

1. The bidder shall furnish six copies of operating and maintenance instructions and illustrated parts books covering the load bank and auxiliary equipment which will require operating instructions and periodic maintenance.

Q. Commissioning

1. Furnish the services of a competent, factory-trained engineer or technician to be available at the job site for period of one day for initial start-up and for instruction personnel in operation and maintenance of the equipment, on the dates requested by the Owner.

R. Equipment Warranty

1. Equipment furnished under these Specifications shall be guaranteed against defective parts and workmanship under terms of the manufacturer's and dealer's standard warranty. But, in no event, shall it be for a period of less than two years from date of initial start-up of the system and the job site and shall include labor and travel time for necessary repairs at the job site. Running hours shall not be a limiting factor for the system warranty. During the guarantee period, the manufacturer shall respond to the emergency within less than two hours. Two hour response shall be provided for two years around the clock.

S. Alternates

1. Manufacturer shall submit value engineering alternates with cost reduction.

OEM
7 WTC

PPS-24

Generators
March 20, 1998

PPS-Generators

2.08 GENERATOR POWER AND CONTROL SWITCHGEAR

- A. The generator power and control switchgear shall incorporate a cubicle for each engine-generator set, plus future, a master cubicle, and cubicles containing outgoing feeder circuit breakers as indicated elsewhere.

The generator power and control switchgear shall incorporate the following features and functions:-

1. In response to the activation of voltage sensing relays in the control switchgear via circuitry runs from automatic transfer switches (as described elsewhere), controls within the switchgear shall automatically initiate engine cranking, as described hereinbefore, for each of the generator sets connected to the switchgear. The generator sets shall each be automatically brought up to stable operating conditions.
2. The first set to reach 90% of nominal voltage and frequency shall be automatically connected to the switchgear bus by electrically closing its circuit breaker. As successive sets reach stable conditions, they shall each be automatically synchronized and paralleled with the generator sets already connected to the switchgear bus.
3. Load shall be picked up in stages and applied to the switchgear bus automatically by electrically closing the outgoing feeder breakers in the switchgear in a pre-determined sequence. The sequence shall be such as to avoid overloading of the generators during the synchronizing process, and shall be manually adjustable in the field. Failure of any set to start shall cause lock-out of all loads beyond the capacity of the remaining sets.
4. Switchgear control and instrumentation shall comply with previously specified requirements for the accommodation of non-linear (i.e., harmonic-producing) loads.
5. As load is applied to, or removed from, the switchgear bus, generator set control in the switchgear shall automatically divide the load so that it is equally shared between the sets.
6. Shutdown of any generator set which had been connected to the switchgear bus shall automatically cause load to be "dumped" by opening outgoing feeder breakers in the switchgear in a pre-determined, field adjustable sequence as necessary to avoid over-loading of the remaining sets.

OEM
7 WTC

PPS-25

Generators
March 20, 1998

PPS-Generators

7. Controls shall be included in the switchgear for the automatic shutdown of any generator set in the event of high jacket water temperature, low lube oil pressure, over-speed as determined by sensors mounted on the engine. Annunciation shall be included for the following "pre-alarm" and "actual alarm" conditions:-

- a. Low jacket water temperature -- pre-alarm
- b. High jacket water temperature -- pre-alarm.
- c. Low lube oil pressure -- pre-alarm.
- d. Battery low voltage -- pre-alarm.
- e. Overcrank (engine failed to start) -- actual alarm.
- f. Over-speed -- actual alarm (shutdown).
- g. High jacket water temperature -- actual alarm. (shutdown).
- h. Low lube oil pressure -- actual alarm (shutdown).
- i. Reverse power -- actual alarm (shutdown).
- j. Failure to parallel -- actual alarm.
- k. Circuit breaker lockout -- actual alarm.
- l. Status only indicator as follows:

Controls not in Automatic	Flashing	Red
Circuit Breaker Open	Status	Green
Circuit Breaker Closed	Status	Red
Engine Running	Status	White
Circuit Breaker Closed Failure	Status	Red
Control Voltage Failure	Status	Red
Auto Start	Status	White

Spare lights shall be furnished for a total of twenty-four.

OEM
7 WTC

PPS-26

Generators
March 20, 1998

PPS-Generators

Provide form C (n/o-n/c) dry contacts for each of the above pre-alarms and shutdowns for interface with the BMS system. Bring wiring out to a set of terminals dedicated for this interface for the BMS contractor to extend from.

The indications shall be of the manual reset type. An alarm silencing switch and "alarm silenced" pilot light shall be included.

8. Controls shall be included in the switchgear for the tripping and lock-out of the circuit breaker for each generator set in response to reverse power, over-current or the failure to parallel.
9. Controls shall be included in the switchgear for the automatic disconnection of generators from the switchgear bus in a pre-determined field adjustable sequence as load falls, and the restoration of generators to the bus as it increases.
10. Controls shall be included in the switchgear for the simultaneous automatic disconnection of all generators from the switchgear bus in response to the activation of contacts indicating that all outlying automatic transfer switches have retransferred to the "normal position".
11. Provisions shall be included in the switchgear for the field installation and wiring of ground fault sensors, relays and monitor panels described elsewhere as part of the ground fault interrupting system.
12. Controls shall be included in the switchgear to shut down each generator set after an adjustable time delay period of five to twenty-five minutes following its disconnection from the switchgear bus.
13. Provisions shall be included in the switchgear for the manual starting, synchronizing and shutdown of each generator set, as well as the manual operation of each generator circuit breaker and outgoing feeder circuit breaker.
14. Provisions shall be included in the switchgear for the testing of the automatic starting and synchronizing sequence under "no load" conditions.
15. An audible signal and a visual indication shall be provided at the switchgear for the following "system pre-alarm" and "system actual alarm" conditions:-
 - a. Low fuel in main tank -- pre-alarm.
 - b. Over/Under voltage -- pre-alarm.
 - c. Over frequency -- pre-alarm.

OEM
7 WTC

PPS-27

Generators
March 20, 1998

PPS-Generators

- d. Under frequency -- actual alarm (load dump).
16. Controls shall be included in the switchgear for the automatic "dumping of load" by opening the outgoing feeder breakers in the switchgear in a pre-determined field-adjustable sequence in the event that the system frequency drops sufficiently to cause an alarm condition for a pre-determined period of time. Load shall be "dumped" until system frequency is restored to normal.
17. Meters, instrument transformers and instrument switches shall be incorporated to provide metering of:-
 - a. For each generator -- the voltage between each pair of phases and between each phase and neutral.
 - b. For each generator -- the current in each phase.
 - c. For each generator -- the KW output.
 - d. For each generator -- the frequency.
 - e. For each generator -- running time meter.
 - f. For the system bus -- the voltage between each pair of phases.
 - g. For system bus -- the frequency.
 - h. For system bus -- KW output.
 - I. For system bus -- synchroscope
18. For each generator, a relay shall be incorporated independent of all other functions which provides three open and three closed when generator running contacts suitable for external alarm or sensing circuit use.
19. Provide the following status only lights:

Manual Paralleling Available	Green Color
Bus Underfrequency Alarm	Red Color
Load Shed Circuits Activated (One for each priority)	Amber Color
Load Shed Bypass (One for each priority)	Amber Color
Engine Generator Status Lights (One for each Engine Generator)	

OEM
7 WTC

PPS-28

Generators
March 20, 1998

PPS-Generators

Running	White Color
On Line	White Color
Lockout	Red Color

Spare lights shall be provided for a total of twenty-four (24).

The indications shall be of the manual reset type. An alarm silencing switch and "alarm silenced" pilot light shall be included.

Provide form C (n/o-n/c). contacts for each of the above pre-alarms and shutdowns for interface with the BMS system. Extend wiring out to a set of terminals dedicated for this interface for the BMS contractor to connect to.

- B. The generator power and control switchgear shall be of the free-standing, deadfront, totally metally enclosed, externally operable type, conforming to N.E.M.A. Class III switchboard construction, consisting of an assembly of standardized vertical sections, each having rigid frame construction of heavy gauge formed steel, including bottom closer plate, rustproofed, primed and painted to provide an overall even appearance. Include a 12" horizontal separation between "service" disconnected feeder devices (circuit breakers). The switchgear shall conform to the following:-

1. No current carrying parts shall be within 12" of the finished floor.
2. It shall have complete phase leg bussing, suitably braced and suitable for the voltage applied. It shall also have a half size neutral bus which shall extend the same length as the phase leg bussing. A 3" x ½" copper (base bid) or 4" x ½" aluminum (deduct alternate) ground bus shall extend for the entire length of the switchboard. The neutral bus shall be bonded to the ground bus by means of (2) 500 MCM insulated copper cables. Bussing indicated as main, including connection to generator circuit breakers, shall be, per phase, as follows:-
 - a. Main bussing designated with an ampere rating shall be sized based on a rating of 1000 amps per square inch of copper (base bid) or 750 amps per square inch of aluminum (deduct alternate). Where the sum of the generator circuit breaker trip sizes exceeds the indicated ampere designation for the main bus, the rating of the main bus shall be increased, for its entire length to the sum of the generator circuit breaker trip sizes, unless divergent load paths reduce the load requirements. In such case, the divergent sections of bus ("A" and "B") shall total 125% of generator breaker trip ratings, and the rating of each section shall be calculated as:-

OEM
7 WTC

PPS-29

Generators
March 20, 1998

PPS-Generators

$$\text{Section "A" Trip Sizes)} = 1.25 \times \frac{(\text{Sum of Generator Circuit Breaker Trip Sizes}) \times (\text{Sum of Feeder Breaker Frame Sizes Supplied by Section A})}{(\text{Sum of Feeder Breaker Sizes Supplied by Section A and B})}$$

- b. It shall be braced to withstand the stresses produced by the fully displaced peak of a symmetrical short circuit current equal to that produced by a bolted short circuit supplied by all generators, present and future, and a 50% motor load. In no case shall the bus be braced for less than 100,000 A/C.
3. It shall have a top pull box consisting of #10 gauge removable sheet metal plates mounted on an angle iron frame, a 1" polyester resin fiberglass bottom barrier and inside cable racks.
4. It shall incorporate isolation transformers, filtering equipment, current and voltage sensing devices which sense RMS values, frequency sensing devices which sense zero crossover and other appurtenances as required to compensate for the distortion produced by SCR power supplies as described hereinbefore.
5. It shall include one master cubicle and one cubicle for each of the generator sets.
6. The master cubicle shall incorporate:-
 - a. Priority Load Control

Output contacts shall be provided to control priority load blocks. The number of load blocks shall equal the number of engine generator sets plus future and shall be sized such that the connectable load of each block is not greater than the kilowatt rating of the generator set connected. As the generators are randomly connected to the bus, the controls shall signal for the connection of the load blocks in an ascending sequential priority with the highest priority load requiring emergency power being connected first. Load shedding shall be done on a last-on, first-off basis.

A priority pass-along circuit shall initiate the connection of low priority loads to the first generator on-line if start signals have not been received from high priority transfer switches.

OEM
7 WTC

PPS-30

Generators
March 20, 1998

PPS-Generators

b. Manual Paralleling Controls

A selector switch shall be provided to select any generator for manual paralleling. The switch shall simultaneously connect a phase band monitor, synchroscope and manual paralleling pushbutton switch to the selected generator.

A solid state Synchronizing Phase band Monitor, Device 25C, shall be furnished a sync check relay for manual paralleling, pushbutton until the oncoming generator is within 15 degrees of synchronism.

Operation shall be arranged so that the operator will depress and hold the manual paralleling pushbutton switch. When the relative phase angle reduces to 15 degrees and is going toward zero degrees. Device 25C will initiate the closing of the respective oncoming generator breaker. The manual paralleling pushbutton switch shall be connected to the selected generator by the synchroscope selector switch. All controls and metering for manual paralleling shall be grouped in a central convenient location on the front of the master control section.

c. DC Control Power Selector - Best Battery System

- 1) Each generator control unit shall utilize the engine starting batteries, and a DC-to-DC converter for each engine generator to provide a 24 Vdc power supply to the generator control PLC power supply, as backup, during starting and cranking of all engine generator sets "simultaneously".
- 2) Control power for the system logic shall be derived from the engine starting batteries and a separately supplied DC station battery system. The control logic shall be powered through a suitable means which shall permit continuity of power until the last battery is no longer available. The controls shall be powered from any battery or combination of batteries and prevent feedback to a failing battery. The transition of control logic power from any battery combination to any other battery combination shall be accomplished without disruption in the power flow. A system logic DC-to-DC converter, shall be supplied to provide a 24Vdc power supply to the system logic PLC power supply, as backup, during starting and cranking all engine generator sets "simultaneously". The DC-to-DC converter shall not permit the voltage to drop below the 24Vdc nominal.

OEM
7 WTC

PPS-31

Generators
March 20, 1998

PPS-Generators

The switchboard station battery shall be identical to the engine starting batteries as described herein.

- 3) Control power distributed from within the system logic control unit shall require a discrete circuit isolated through a protective circuit breaker. Control power distribution circuit shall be defined, but not limited to a minimum of (30 circuits, each with its associated circuit breaker:

- Generator and Total system PLC DC bus - DC to DC converter, etc.
- Non PLC, System Logic Bus.
- ATS/Customer Interface DC Bus for customer external connections (engine start signals, etc.)

d. Bus Underfrequency Protection

The generator bus shall have a solid-state frequency monitor (Device 81B) with integral time delay to initiate load shedding upon a reduction of bus frequency to 58 Hz or less for a period of two seconds or more. Upon sensing a bus underfrequency, the system shall automatically shed the lowest priority load connected at the time of occurrence. This shed circuit shall override any manual load-add operation and shall lock out the manual load-add circuitry. It shall give visual and audible alarm annunciation of bus underfrequency load shed.

e. Load Shed Bypass-Reset Pushbutton

Provide a pushbutton, load shed bypass-reset control switch. The switch shall provide for supervised operation over the load-shed, load-add circuits. controls shall be provided so that in the event a bus overload occurs resulting in a reduction in bus frequency, the lowest priority load will be shed automatically by an override circuit. One switch shall be provided for each priority block except first priority.

f. Main Bus Underfrequency Reset Pushbutton

Provide a bus underfrequency reset pushbutton to reset bus underfrequency load shed signal.

PPS-Generators

g. System Test Switch

Provide a system no-load test switch to initiate a complete automatic system operation by simulating the closure of the remote engine start signal. This switch shall be mounted inside the master section to limit access to authorized personnel only.

h. Master Audible Alarm

Provide a master audible alarm. The alarm horn shall be the DC vibration type, adjustable from 78 to 102db. Include an alarm silencing pushbutton and circuitry to allow subsequent malfunctions to resound the alarm if the horn had been previously silenced following an initial malfunction.

i. Load Demand Control

Load demand control logic shall be provided to sense the load connected to the bus and establish the proper number of sets to operate to maintain the connected load with the minimum on-line reserve generating capacity of 10% of the rating of a single set. The load demand control logic shall initiate the disconnection of a generator from the bus whenever the on-line reserve generating capacity exceeds 120% of a single generator.

The load demand control logic shall have adjustable set points for initiating the addition to, and removal from, the bus of the generator sets. The load demand control logic shall be designed to maximize field economy while maintaining sufficient capacity to service the load.

Upon sensing that the on-line reserve capacity has increased to 120% or more, a 180 second time delay (adjustable 0-300 seconds) shall be initiated. If the reserve capacity stays above 120% for the duration of the time delay, the circuit breaker of the last set that went on line shall be opened. The engine shall run for its cooldown period, then shutdown.

j. Bus Load Optimization

If a generator fails while operating in the emergency mode, it is disconnected from the bus and shutdown. The lowest priority loads are shed. Audible and visual alarms will be activated to indicate the condition.

OEM
7 WTC

PPS-33

Generators
March 20, 1998

PPS-Generators

After a stabilization period, (user adjustable, 0-03 minutes), the shed loads shall be automatically readied to the emergency is in discrete load increments until the until the bus has been loaded to 95 % of it capacity.

- k. The plant operator can manually override the predetermined loading sequence by turning the bus load optimizer selector switch to the "off" position. Individual "off-auto-on" selectors are provided for each discrete load. By operating these switches, the plant operator may remove and/or add individual loads as required. A light shall indicate when a load has been signaled to connect to the bus. A status light will light when bus has been loaded to 95 % capacity and shall be labeled "Bus Loaded to Capacity." Should the plant operator inadvertently overload the bus between 110 % and 115 % the bus capacity, the unsupported load block (a block of load for which no generator is connected to the bus) shall be reshed.

If at any time the bus is overloaded greater than 115 % of the bus capacity or the bus frequency drops to 58 Hz or less for more than two seconds, then all bus optimizing loads as well as the lowest priority supported load block connected to the bus are shed. A status light annunciating a "Bus Overload" shall be activated examined by the plant operator. After taking appropriate actions, the condition may be reset via the "Bus Overload Reset" pushbutton.

- l. Load Priority Selection

Each load shall be assigned a block shedding priority. The total user assigned load for each priority block shall not exceed the capacity of one engine generator set.

Each discrete load shall have a user assigned load re-add step #(1,2,3....30). If a block of lad has been shed, the individual loads will be added back onto the bus in ascending order of the load step re-add# until the engine generator sets have reached 95 % of capacity.

Each discrete load shall also have a user entered maximum load DW value assigned to it. This value shall be used to determine if particular load can be re-added to the bus without exceeding the available bus capacity.

PPS-Generators

A data keypad type operator interface shall be provided to enter the above data into the system's PLC. This unit shall also be usable as a field monitoring device for the PLC's I/O. The unit shall not be capable of changing any user values unless a keyswitch located at the PLC enables its use.

m. Master PLC Redundancy

- 1) Total System control unit shall contain a master PLC (Programmable Logic Controller). PLC shall be capable of controlling the entire Emergency Power System, including engine generators and controllable loads, for all operations
- 2) The total system PLC shall have a redundant PLC and they shall back each other up. Each PLC shall have a central processing unit (CPU) each PLC shall share the intelligent input/output (I/O) system that monitors/controls all necessary functions of the system. The I/O shall communicate over a twisted pair to and from the CPU at 153.6Kbaud. Both CPUs shall have identical programs, read inputs and shall solve their algorithms simultaneously. However, the primary and intelligent I/O system will only update its output per the primary CPU's command. the primary and secondary CPU's shall be arbitrarily assigned such that if the I/O system does not sense an update from the primary CPU the I/O system will temporarily hold the current state of the outputs. If after three communications scans, approximately 20 ms, the primary PLC is not recognized, the I/O shall transfer control over to the secondary CPU. the I/O system shall then update it's outputs accordingly.
- 3) In this application, since both programs are identical there will be a "bumpless" transfer between CPU's. When the primary CPU has been restored, and is communicating correctly, the I/O system shall reverse the process to transfer control back to the primary CPU.

- n. Provide a manual override panel to allow an operator to manually load add/shed the loads in the event of a master PLC failure, or loss of the master cubicle 2 and V DC power supply.

OEM
7 WTC

PPS-35

Generators
March 20, 1998

PPS-Generators

Upon the master PLC failing or loss of the master DC power bus, the load add/shed circuitry of the PLC becomes inoperative. Simultaneously, the Manual Override panel is enabled. The operator can manually add/shed loads through the activation toggle switches. These switches are individually wired in parallel with the PLC add/shed outputs. During this condition, the operator must observe the generator kW meters to ensure the generators are not overloaded. In the event that an overload condition does occur, all manually transferred ATS' will be shed from the bus. The operator would then deactivate the appropriate toggle switches to reduce the load. A manual reset button located on the override panel would have to be depressed to restore the manual override circuit.

An on-line UPS shall be provided as an alternate power source to back-up the system logic for the PLC. This UPS shall be constantly on-line when the engine generators are available. The on line UPS shall be sized to handle the PLC provided.

- o. Master control cubicle shall be capable of mounting and wiring a remote I/O devices supplied by building management system. I/O device shall be capable of receiving an analog signal from the master PLC to represent total generator output KW available. Signal shall be 4-20mA and scale shall be shown on switchgear controls MFG interface dwg. Signal shall be used by BMS to evaluate if additional mechanical loads can be added to the generators. At least 5 digital signals shall be available for status indication to BMS for shedding or previously added loads due to generator failure or bus overload, or as a permissive to allow BMS load add.

I/O device should also be capable of receiving digital signals for all pre-alarms and shutdowns for each generator as well as all status points in master control section. These points are defined in other parts of this spec section.

7. Each generator cubicle shall incorporate:-

a. Generator Circuit Breaker

A low voltage circuit breaker shall be furnished to provide overcurrent protection and paralleling functions. The breaker shall be as sized on drawings, 3 pole, electrically operated, drawout, with solid state trip elements. Trip elements shall include adjustable long delay, short delay, ground fault alarm only and instantaneous settings. Breakers shall have 5 cycle stored energy closing. Drawout feature shall provide for connected test and disconnected positions. In the connected position the main line

OEM
7 WTC

PPS-36

Generators
March 20, 1998

PPS-Generators

and load terminals and all auxiliary control contacts and circuitry only shall be connected to permit automatic operation of the complete control system without actually connecting the generator to the main bus. In the disconnect position, main and auxiliary control contacts and circuitry shall be completely disconnected. The breaker drawout mechanism shall be mechanically interlocked with the breaker to permit drawout operation only when the breaker main contacts are open.

b. Generator Sensing Control

Control sensing panel shall be furnished to protect, monitor, and control the operation of each generator set.

Each generator sensing panel shall include the following components, devices, and indicators:

1) Reverse Power Protective Relay (Device 32)

An adjustable reverse power solid state relay shall be provided to detect a motorizing condition of the respective engine generator set. The trip setting shall be adjustable from 0 to 15% of the forward power rating of the respective engine generator set. Response shall be independent of frequency over a range of 40 to 70 Hz. The relay shall include a test switch to enable the relay circuit to sense forward power for periodic testing and adjustment. The relay shall include a solid state linear time delay to insure compatibility with engine driven generator set characteristics. The time delay shall have a range of adjustability of 0.1 to 60 seconds and be factory set at 2.0 seconds. The relay shall respond to power, the inphase component of current, across a power factor range of 0.2 to unity, leading or lagging, with a repeatability within plus or minus 3.0%. Do not substitute relays with inverse time characteristics.

2) Generator Voltage Protective Relay (Device 27)

An undervoltage solid state relay shall be included to respond to the true r.m.s. value of the generator voltage. This relay shall have an adjustable pick up range of 75 % to 100% nominal and an adjustable dropout of 80% of pickup. Dropout shall have zero differential for time delay reset.

OEM
7 WTC

PPS-37

Generators
March 20, 1998

PPS-Generators

3) Generator Frequency Protective Relay (Device 81)

An underfrequency solid state relay utilizing full cycle zero crossing sensing shall be included to respond to the fundamental frequency of the system so as to ignore wave shape distortion resulting from solid state loads. The relay shall have an adjustable pick up range of 40 to 60 Hz and adjustable under frequency dropout range of 0.1 to 10 Hz below the pickup.

4) Frequency/Voltage Time Delay

An adjustable time on drop out of both Device 27 and 81 shall be provided to override loading transients. Range of adjustability shall be 0.1 to 6.0 seconds, factory set at 2.0 seconds. repetitive accuracy shall be within plus or minus 2%.

5) Automatic Synchronizer (Device 25)

An automatic solid state active synchronizer shall be furnished to synchronize its respective incoming engine generator set with the paralleling bus. The synchronizer shall include a differential voltage detector, differential frequency detector, differential phase detector, raise/lower voltage output relays for generator voltage control, raise/lower frequency and phase angle control through a proportional DC output voltage, phase lock control and a circuit breaker closing signal. Synchronizers without phase lock control are unacceptable. Synchronizer shall be ASCO or woodward SPM-A.

The differential voltage detector shall compare the voltage of the oncoming generator to the paralleling bus. If the voltage is not within the factory set difference of plus or minus 5% (adjustable from 0 to plus or minus 10%), the voltage detector shall lockout the circuit breaker closing relay and simultaneously initiate adjustment of the voltage through the raise/lower voltage output relays. When the oncoming generator voltage is within the preset acceptable limit, the lockout shall be removed. Repetitive accuracy of the voltage detector shall be plus or minus 1.0 over the specified temperature range.

The differential frequency detector shall compare the frequency of the oncoming engine generator set to the paralleling bus. If the frequency is not within the preset acceptable difference of plus or minus 0.5 Hz (adjustable from 0 to plus or minus 0.5

OEM
7 WTC

PPS-38

Generators
March 20, 1998

PPS-Generators

- Hz), the frequency detector shall lockout the circuit breaker closing relay and simultaneously generate a DC voltage proportional to the frequency difference to cause the engine governor to bring the frequency within the preset acceptable limit. When the oncoming engine generator frequency is within the acceptable limit, the lockout shall be removed.

When the voltage and frequency limits are satisfied, and the relative phase angle between the oncoming unit and the bus reduces to 5 degrees approaching zero degrees, the synchronizer shall hold (phase lock) the generator output in synchronism with the bus, the circuit breaker closing relay shall close to initiate breaker closing and paralleling. DC control of the governor and voltage control shall be terminated simultaneously with breaker closure. The complete system shall function in such a manner as to insure that the maximum relative phase angle at the instant of paralleling does not exceed 5 electrical degrees.

6) Control Circuit Status Indicators

Color-coded, light-emitting diodes shall be provided on the generator sensing panel to indicate the control circuit status of the following conditions:

DC Input Power On	Red Color
Generator voltage and frequency acceptable	Green Color
Synchronizer Energized	Green Color
Selector Relay On	Yellow Color
Reverse power trip setting exceeded	Yellow Color
Generator Voltage Too High	Red Color
Generator Voltage Too Low	Red Color
Synchronizing Output Relay On	Yellow Color
Reverse Power Trip Setting Exceed for 2.0 sec; RPR Latched On	Red Color

7) Engine Cooldown and Failure to Synchronize Time Delay Relays

OEM
7 WTC

PPS-39

Generators
March 20, 1998

PPS-Generators

- Plug in, solid state time delays shall be provided for unloaded cooldown, adjustable from 0 to 15 minutes (factory set at 15 minutes). The cooldown time delay shall be adjustable from 1 to 3 minutes (factory set at 3 minutes) and automatically bypassed for malfunction and manual shutdown of the engine generator set. The failure to synchronize time delay shall be adjustable from 1 to 3 minutes (factory set at 3 minutes) and provide audible and visual indication but shall not terminate synchronizing attempts nor shut down the engine.

c. Engine Starting Control

The engine starting control logic shall be microprocessor based and shall automatically start, protect and monitor each engine generator set. Electro-Mechanical engine start controls are unacceptable. The engine starting control logic shall be capable of controlling engines furnished with the following:

- 1) Starting motor magnetic switch.
- 2) Electrically operated fuel control.
- 3) Normally open protective switches that close for abnormal conditions of pressure, temperature, speed and liquid level when required.

The engine starting control logic shall provide electrically isolated contacts for electronic governor control, electric fuel control, battery charger disconnect during craning and common shutdown alarm annunciation. All relays shall be the same as interchangeable with, the relays specified in Generator Sensing Panel section.

1) Engine Start/Stop Operation

The automatic engine control logic shall initiate operation of the engine upon receipt of a signal from a contact which closes for engine run and opens for engine stop. Upon start of the engine, the engine control logic shall automatically disconnect the starting motor and prevent its reconnection until the engine has come to a complete rest.

OEM
7 WTC

PPS-40

Generators
March 20, 1998

PPS-Generators

If the engine fails to start after 4 adjustable cranking attempts (factory set at 10 seconds on and 10 seconds off, adjustable from 5 to 30 seconds) or if any protective device should operate while the engine is running, the engine shall be disconnected from service and immediately stopped. The engine control logic shall lock the failed set out of service and requires a manual reset. The engine control logic shall include a provision for conversion to single cycle cranking, adjustable from 35 to 210 seconds.

2) Five Position Engine Control Switch Operation

Stop/Reset - In this position, the engine shall not be capable of starting and/or running. If the engine was shutdown due to the operation of a protective device, the shutdown malfunction shall be reset when the switch is moved to this position. If the engine is running when the switch is moved to this position, it shall immediately shut down.

Off/Cooldown - In this position, the engine shall shut down after a cool down period.

Automatic - In this position, the engine control shall be in readiness for fully automatic operation upon receipt of a start signal.

Test-Off-Line - When placed in this position, the engine shall start and run as if a start signal were received except it shall not be connected to the bus unless a start signal is received. When returned to the Automatic position, the engine will shut down.

Test-On-Line - When placed in this position, the engine shall start, run and connect to the bus as if a start signal were received. When returned to the Automatic position, the circuit breaker will open and the engine will run for its cooldown period before shutting down.

d. Synchronizing Mode Selector Switch

The synchronizing mode selector shall have the following positions:

- 1) **Permissive** - In this position, the governor controls are deactivated. However, the synchronizer can operate as a passive synch check relay and signal the closing of the generator breaker.

OEM
7 WTC

PPS-41

Generators
March 20, 1998

PPS-Generators

- 2) Check - In this position, the synchronizer is fully operational except it cannot close the generator breaker. The phase-lock feature holds the generator output in synchronism with the bus.
 - 3) Off - In this position, the synchronizer is turned off to allow for manual paralleling at the Master Cubicle.
 - 4) Run - In this position, the fully operational automatic mode.
- e. Failure to Synchronize Reset Switch
- 1) A momentary pushbutton switch shall be provided to reset the "fail to synchronize" alarm.
- f. Current Transformers
- Current transformers shall be furnished with V > A > burden ratings suitable to supply the metering, protective devices and electronic governor without affecting their accuracy. Ratios shall be selected to cause ammeter scale deflection to the top 25 % of scale at the full load rating of the engine generator when computed at 0.8 pf.
- 1) All current transformers shall have shorting type terminal blocks.
- g. Potential Transformers
- Potential transformers shall be provided in turns ratio and VA burden rating to be compatible with the controls, metering and the electronic governor. Transformers shall have primary and secondary fuses.
- h. Engine Governor, Generator Voltage Regulator and Miscellaneous Engine Generator Set Controls
- Engine Generator Set Controls
- The switchgear manufacturer, shall mount and wire all electronic and electric controls associated with the engine generator set governor and/or voltage regulator as described in the engine generator set specifications. These controls shall be furnished by the engine generator set distributor to the switchgear manufacturer for mounting and wiring. The controls will include, but not be limited to the following:
- 1) Electronic control portion of governor.

OEM
7 WTC

PPS-42

Generators
March 20, 1998

PPS-Generators

- 2) Voltage Regulator.
 - 3) Motorized Voltage Adjust Potentiometer.
 - 4) Cross Current Compensation Transformer.
 - 5) Isolation Transformers.
8. Outgoing feeder cubicles shall each contain 3 pole, 600 volt stored energy type, electrically operated air circuit breaker with adjustable long, short time and instantaneous and ground fault (alarm only) overcurrent trips, sized as indicated on the drawings. Each breaker shall be provided with a control switch and pilot lights. Each feeder cubicle shall incorporate ground fault sensors and alarm relay with (2) N.O. and (2) N.C. contacts. Include visual and audible indication of alarm. Alarms shall be displayed on front face of switchgear. Each breaker shall contain current limiting fuses for 200,000 A.I.C. rating and fuses shall be sized to provide downstream protection (series rated) for equipment such as automatic transfer switches, etc.
 9. All generator circuit breakers shall have adequate interrupting capacity for the maximum short circuit that they will be required to interrupt. The maximum short circuit shall be calculated in during the motor contribution.
- C. Generator power and control switchgear shall be manufactured by Russelectric, Automatic Switch Company. Any alternate shall be submitted to the consulting engineer in writing 10 days prior to bid. Each alternate bid must list any deviations from this specification.
- D. Factory Test
1. The generator power and control switchgear shall be tested at the factory to demonstrate compliance with the Specifications. Tests shall be witnessed by the Owner and/or his representative. A certified copy of the performance test shall be submitted before shipment to the job site. Any defects which become evident during the test shall be corrected before continuing.
- E. Site Tests
1. Manufacturer shall provide the services of factory trained engineer and the technicians to conduct and supervise site tests.

OEM
7 WTC

PPS-43

Generators
March 20, 1998

PPS-Generators

2. Supplier shall inspect the unit after installation. Any deficiency with the installation shall be brought to the attention of the contractor for repair or alteration. The unit shall be started up and run to determine that all systems are functional.

F. Operation and Maintenance Manuals

1. The bidder shall furnish six copies of operating and maintenance instructions and illustrated parts books covering the generator power and control switchgear and auxiliary equipment which will require operating instructions and periodic maintenance.

G. Commissioning

1. Furnish the services of a competent, factory-trained engineer or technician to be available at the job site for period of two days for initial start-up and for instruction personnel in operation and maintenance of the equipment, on the dates requested by the Owner.

H. Provide short circuit and coordination study for emergency power system from generators down to ATS's.

2.09 AUTOMATIC TRANSFER SWITCHES

- A. Automatic transfer switches shall, for the indicated amperage and voltage, conform to the performance requirements specified below. The switches shall be for operating characteristics as indicated and shall be complete with all integrally mounted and wired up components as required to automatically transfer a load back and forth between a normal and an emergency source under the conditions specified below.

- B. Submit manufacturers certification attesting to the fact that, at the specified voltage, the main contacts of each transfer switch:-

1. Are capable of carrying the specified amperes continuously without damage when mounted in the specified enclosure and with such enclosure located in a space having an ambient temperature of 110°F.
2. Are for at least 50 operations and without damage of any sort, including pitting, able to interrupt a low power factor (40% or less) current equal to 6 times the continuous requirement.
3. Are, without damage of any sort, able to handle a closing current surge equal to 10 times the continuous requirement.

OEM
7 WTC

PPS-44

Generators
March 20, 1998

PPS-Generators

- C. Submit manufacturers certification attesting to the fact that the withstand rating of each transfer switch equals or exceeds the interrupting capacity of the upstream protective device, or the available fault current if less than the interrupting capacity of the upstream device.
- D. Basic features required for each transfer switch are as follows:-
 1. It shall be of the 3-pole type when interposed in a 3-wire feeder, and of the 4-pole type when interposed in a 4-wire feeder, regardless of any other indications to the contrary.
 2. It shall be of the mechanically held, mechanically and electrically interlocked type which excludes any possibility of paralleling the normal and emergency sources.
 3. Each switch shall have a neutral position (i.e., load disconnect-for an adjustable time from 0 to 10 seconds-from both normal and emergency sources) to which it can be thrown during transfer and retransfer (by its electric controls) or in the "test" mode. In lieu of a neutral position, "in-phase monitoring" control of transfer and retransfer will be acceptable.
 4. It shall be in N.E.M.A. Class I enclosure.
 5. All components and connections within the enclosure shall be located so as not to require rear access.
 6. It shall have a 1 % accuracy 4" ampmeter, mounted on the front with ampmeter selection switch to measure load current in each phase and neutral. Ampmeter ranges shall be specific for each switch size neutral position shall be only provided in 3 ϕ /4w feeders.
- E. Except as noted below the automatic control features of each transfer switch shall:-
 1. Be such as to transfer the load from the normal to the emergency source as soon as "stable operation" voltage and frequency conditions (within the tolerances specified elsewhere for the associated emergency generating sets) is sensed at the emergency terminals of the transfer switch.

Transfer controls shall incorporate a feature which provides an adjustable time delay from 0 to 30 seconds between the sensing of stable conditions and the initiation of transfer.

OEM
7 WTC

PPS-45

Generators
March 20, 1998

PPS-Generators

2. Be such as to prevent transfer of the load onto the emergency source when the voltage on all phases of the normal terminals is 70% or more (field adjustable) of the average value maintained under normal conditions. (Except under test conditions.)
3. Be such as to retransfer the load to normal source when all phases of the normal source are restored to at least 90% of their normally maintained value. Retransfer controls shall incorporate a feature which provides for a 5 to 25 minute adjustable time delay between the sensing of the specified level of normal source and the initiation of retransfer. If generator voltage fails during the delay period, immediate retransfer shall occur.
4. Incorporate in both transfer and retransfer controls a feature which provides for an adjustable time period of 0 to 10 seconds during which the switch remains in its neutral position as described above.
5. Incorporate two pilot lights to indicate transfer switch position.
6. Incorporate a generator cranking feature including an open contact for use in an external circuit arranged to close whenever voltage on the normal supply drops below 70% of the average maintained value on any phase for an adjustable period from 0 to 30 seconds.
7. Incorporate a generator shut down feature including an open contact for use in an external circuit arranged to close after an adjustable time delay period of zero to twenty-five minutes following the return of the transfer switch to the normal power position.
8. Incorporate three auxiliary "open when normal, closed when emergency" contacts and three auxiliary "closed when normal, open when emergency" contacts which are not involved in the functioning of the switch and which are suitable for the present or future connection of independent external alarm or sensing circuits.
9. Incorporate a means for manually testing switch transfer and retransfer without necessitating the removal of voltage from the normal source terminals of the switch.
10. Each shall incorporate a control panel that shall direct the operation of the transfer switch. The panel's sensing and logic shall be controlled by a built-in microprocessor for maximum reliability, minimum maintenance, and inherent digital communications capability. The control panel shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the control panel to be disconnect from the transfer switch for routine maintenance.

OEM
7 WTC

PPS-46

Generators
March 20, 1998

PPS-Generators

The control panel shall be completely enclosed with a protective cover and mounted separately from the transfer switch unit for safety and ease of maintenance. Sensing and control logic shall be provided on plug-in printed circuit boards. Interfacing relays shall be industrial grade plug-in type with dust covers. The control panel shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows:

- a. Electrostatic Discharge (ESD) - IEC 801-2
- b. Electrical Fast Transients (EFT) -IEC 801-4 and NEMA ICS-1-109
- c. Surge Withstand - (IEC 801-5 and IEEE 472 (ANSI C37.90A)
- d. Electromagnetic Interference - Mil Std 461, Class 3

F. Provide for each automatic transfer switch noted with BPIS provide a fully-rated bypass-isolation switch (BPIS) manufactured by the automatic transfer switch (ATS) manufacturer. Each (BPIS) shall be adjacent to its associated (ATS), complete with bus connections as required. Submit price difference, if any, for side by side or front to back ATS & BPIS. Each (BPIS) shall incorporate the following features and functions:-

1. It shall be possible to bypass and isolate (for maintenance and/or testing) the ATS without interrupting power to the load served by the ATS.
2. It shall be possible to transfer the load to either the normal or the emergency source when in the "bypass mode".
3. It may be integrally mounted in a common enclosure with the ATS, or field mounted in a separate NEMA I enclosure.
4. Each UPS ATS/bypass shall be of the closed transition transfer type as follows:
 - a. Shall transfer the load without interruption (closed transition) by momentarily connecting both sources of power only when both sources are present and acceptable. The maximum interconnection time is 100 milliseconds. The switch shall operate as a conventional break-before-make (open transition) switch when the power source serving the load fails. Designs that transfer in a delayed transition manner (intentional delay in the neutral position) when closed transition transfer is bypassed are not acceptable.

OEM
7 WTC

PPS-47

Generators
March 20, 1998

PPS-Generators

- b. An inphase monitor shall be provided for closed transition operation. The monitor shall control transfer/retransfer between live sources so that closure on the alternate source will occur only when the two sources are within 5 electrical degrees maximum, 5% maximum voltage difference, and 0.2Hz.
 - c. Closed transition transfer shall be accomplished with no power interruption and without altering the or actively controlling standby generator set.
 - 5. The automatic transfer/bypass isolation switches and accessories shall conform to the requirements of:
 - a. UL 1008 - Standard for Automatic Transfer Switches
 - b. NFPA 70 - National Electrical Code
 - c. NFPA 99 - Essential Electrical Systems for Health Care Facilities
 - d. NFPA 110 - Emergency and Standby Power Systems
 - e. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
 - f. NEMA Standard ICS2-447 - AC Automatic Transfer Switches
 - g. ISO9001
 - G. Transfer switches shall be as manufactured by Automatic Switch Company or Russ-electric. Any alternate shall be submitted to the consulting engineer in writing 10 days prior to bid. Each alternate bid must list any deviations from this specification.

2.10 GRAPHIC ANNUNCIATOR

- A. Provide illuminated graphic mimic panel to show a system one-line including generators, generator switchgear, ATS's, normal feeders and building secondary service switchboards. Provide led indicator for breaker status (open/closed), load shed, ATS position, generator shutdown and ATS (bypass position), utility, etc. Dry contacts shall be provided at the building switchgear and other locations.
- B. Submittal shall include detail information as to size, construction, etc.

(1854.98\elec.pps)

PPS-Generators

Emergency Generator Switchgear Schedule
(480/277 volts, three phase, four wire system)

<u>Device Function</u>	<u>Size</u>
Generator No. 1	1600/800
Generator No. 2	1600/800
Generator No. 3	1600/800
Master Cubicle	2500 Amp main bus
Distribution Breaker No. 1	1600/1600
Distribution Breaker No. 2	1600/1600
Distribution Breaker No. 3	Space only
Distribution Breaker No. 4	Space only
Load Bank Breaker No. 1	1600/1000
Load Bank Breaker No. 2	1600/1000
Load Bank Breaker No. 3	1600/1000
Space only	

OEM
7 WTC

PPS-49

Generators
March 20, 1998

PPS-Generators

Automatic Transfer Switch Schedule
(480/277 volts, three phase, four wire system)

<u>ATS No.</u>	<u>Size, Poles, Switch</u>
No. 1	2000A - 4 pole + BPIS
No. 2	800A - 4 pole
No. 3	400A - 4 pole
No. 4	200A - 4 pole
No. 5	200A - 4 pole + BPIS
No. 6	200A - 4 pole
No. 7	200A - 4 pole
No. 8	100A - 4 pole
No. 9	200A - 4 pole

X:\WP\FILES\1854.98\ELEC.PPS

OEM
7 WTC

PPS-50

Generators
March 20, 1998