PART 1 GENERAL

1.01 SCOPE
A. This specification defines the electrical and mechanical characteristics and requirements for a continuous-duty single-phase, solid-state, uninterruptible power supply system. The uninterruptible power supply system, hereafter referred to as the UPS, shall provide high-quality AC power for sensitive electronic equipment loads with N+X power and logic capabilities with hot swappable power and battery modules to maintain maximum uptime. The UPS shall operate in conjunction with the existing building electrical system to protect electronic equipment from power disturbances that may occur with utility power, such as voltage fluctuations, brownouts, power surges and sags.

1.02 SYSTEMS DESCRIPTION
A. Components
1. Rectifier/Charger
2. Inverter
3. Battery Charger
4. User Interface Panel
5. Sealed Lead Acid Batteries
6. Automatic Bypass
7. Input Line Cord or Hardwired
8. Receptacles or Hardwired Output
9. Serial (RS-232) communication Interface
10. Communication Card Slots (2)
11. Remote Emergency Power Off contacts
12. On Generator Contacts
13. On Bypass Contacts
14. Isolation
15. 20 Amp Charger Module
16. Rack mounting Kit for 3 and 6 slot enclosures
17. Caster Kit for 3 and 6 slot enclosures
18. External Matching Battery Cabinets
19. Wall Mounted Maintenance Bypass Cabinets

* Note to Spec. Writer - Optional
B. Modes of Operation

1. Normal Mode: The rectifier shall derive power as needed from the commercial AC utility or generator source and supply filtered and regulated DC power to the on-line inverter. The inverter shall convert the DC power at its input to highly regulated and filtered AC power for the critical loads.

2. Hi Efficiency Mode: In the presence of favorable incoming utility conditions, the UPS shall optimize its operating state to maximize its efficiency.

3. Battery Mode: Upon complete failure of utility power, the UPS shall provide power to the critical loads through the inverter, from the UPS' internal or extended batteries. When utility power returns, the unit shall return to Normal operation.

4. By-Pass Mode: The automatic bypass shall transfer the critical load to the commercial AC source, bypassing the UPS's inverter/rectifier, in the case of an overload, load fault, or internal failure.

5. Standby Mode: When initially attached to a utility or other power source, the UPS shall start in standby mode until the user initiates power to the critical load. In this mode, the UPS shall recharge the batteries, but power shall not be supplied to the critical load.

6. Sleep Mode: This mode is entered into automatically if utility power is not present and the battery capacity is determined to be insufficient. This mode is normally entered while the unit is shipping or after a low battery shutdown. Its purpose is to protect the batteries in the UPS for longer life.

1.03 RELATED SECTIONS

1.04 REFERENCES

A. The UPS and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA and UL as follows:

1. UL 1778
2. UL 497A
3. CSA22.2 No 107.1 and 107.2
4. NOM-019-SCFI-1993
5. FCC part 15, subpart J, Class B
6. IEEE 587/ANSI C62.41
7. EN50091-1,-2
8. EN61000-4-2,-3,-4,-5

* Note to Spec. Writer - Optional
1.05 SUBMITTALS – FOR REVIEW/APPROVAL
   A. Submit one copy of a concise operation and maintenance manual.

1.06 SUBMITTALS – FOR CONSTRUCTION
   A. Submit one copy of a concise operation and maintenance manual.

1.07 QUALIFICATIONS
   A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
   B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
   C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
   D. *Provide Seismic tested equipment as follows:
      1. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the International Building Code (IBC) for zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, IBC: a peak of 2.45g’s (3.2-11 Hz), and a ZPA of 0.98g’s applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.
         -- *OR --
      1. The equipment and major components shall be suitable for and certified to meet all applicable seismic requirements of the California Building Code (CBC) through zone 4 application. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The test response spectrum shall be based upon a 5% minimum damping factor, CBC: a peak of 2.15g’s, and a ZPA of 0.86g’s applied at the base of the equipment. The tests shall fully envelop this response spectrum for all equipment natural frequencies up to at least 35 Hz.
         -- *OR --
      1. The manufacturer may certify the equipment based on a detailed computer analysis of the entire assembly structure and its components. Guidelines for the installation consistent with these requirements shall be provided by the switchgear manufacturer and be based upon testing of representative equipment. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment.

* Note to Spec. Writer – Optional
* Note to Spec. Writer – Select one
2. The following minimum mounting and installation guidelines shall be met, unless specifically modified by the above referenced standards.
   a. The Contractor shall provide equipment anchorage details, coordinated with the equipment mounting provision, prepared and stamped by a licensed civil engineer in the state. Mounting recommendations shall be provided by the manufacturer based upon approved shake table tests used to verify the seismic design of the equipment.
   b. The equipment manufacturer shall certify that the equipment can withstand, that is, function following the seismic event, including both vertical and lateral required response spectra as specified in above codes.
   c. The equipment manufacturer shall document the requirements necessary for proper seismic mounting of the equipment. Seismic qualification shall be considered achieved when the capability of the equipment, meets or exceeds the specified response spectra.

1.08 REGULATORY REQUIREMENTS
   A. The UPS shall be UL labeled.

1.09 DELIVERY, STORAGE AND HANDLING
   A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10 OPERATION AND MAINTENANCE MANUALS
   A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Eaton / Powerware
   B. 
   C. 

The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten (10) days prior to bid date.

2.02 RATINGS
   A. System Input

* Note to Spec. Writer – Insert data in blanks
1. Input Voltage Operation Range: *Nominal Input Voltage range is 208-240 Vac*  
   [Maximum Input Voltage range is 176-276 Vac]

2. Input Frequency
   a. 45 to 65 Hz
   b. Auto sensing
   c. User selectable frequency range in 0.1Hz increments

3. Input Power Factor is 0.98

4. Input Current Distortion: 10% THD maximum at full load.

5. Inrush Current: 150% of full load input current maximum for 3 cycles

6. Surge Protection: Sustains input surges without damage per criteria listed in ANSI C62.41-1980 (IEEE 587), Category A and B

B. System Output, Normal Mode

1. Nominal Output Voltage
   a. *Input voltages of 208/120, 240/120, 220/127, 220/110 and 200/100 Vac, single-phase, 3-wire-plus-ground (for use with Split Phase Power Modules), yield field programmable output voltages of 208/120, 240/120, 220/127, 220/110 and 200/100 VAC.*
   b. *Input voltages of 208, 220, 230 and 240 Vac single phase, 2-wire-plus-ground (for use with Universal Power Modules), yield field programmable output voltages of 208, 220, 230 and 240 volts

2. Voltage regulation: +/-3% of selected output voltage in steady state

3. Transient Voltage Response:
   a. Voltage Transient Response: +/- 3% maximum while in Double Conversion mode with resistive step loads from 0% to 50%, 50% to 100%, 100% to 50% and 50% to 0%. Or, +/-5% maximum while in Double Conversion mode with resistive step loads from 0% to 100% or 100% to 0%

4. Transient Recovery Time: To within 1% of steady state output voltage within 50 milliseconds

5. Voltage THD:
   a. 3% Total Harmonic Distortion (THD) maximum into a 100 percent linear load
   b. 5% THD maximum into a 100% non-linear load

6. Nominal Frequency: 50 or 60 Hz Auto selectable

7. Frequency Regulation:
   a. Sync with line within +/-3 Hz of nominal line frequency, or
   b. Transfer to battery power with frequency at +/-0.1Hz of the selected nominal frequency if out of +/-3 Hz specification.

8. Output Current: Maximum output current (at nominal output voltage) for the UPS shall be:  
   *3kVA system: 25A @ 120V*  
   *6kVA system: 50A @ 120V*  
   *9kVA system: 75A @ 120V*  
   *12kVA system: 100A @ 120V*  
   *15kVA system: 125A @ 120V*  
   *18kVA system: 150A @ 120V*

* Note to Spec. Writer – Select one
9. Current Overload Capability:
   a. 150% for 10 seconds
   b. 300% for 12 cycles

10. Bypass:
    a. Automatic bypass shall provide an alternate path to utility power in the case of
       overload, UPS failure and excessive transfers while in High Eff. Mode
    b. External Maintenance Bypass can be utilized with the UPS to all servicing of the
       UPS. There are MBB and BBM bypass switches available
    c. Transfer time to and from any internal bypass shall be no-break

11. Efficiency:
    a. Minimum of 97% while in High Efficiency Mode
    b. Nominal 88% in Normal Mode with full resistive load and fully charged batteries

C. System Output, Battery Mode:
   1. Nominal Output Voltage: This shall be the user selected output voltage. This
      must be entered into the UPS prior to turning the UPS on.
   2. Voltage Regulation: +/-3% of selected nominal voltage
   3. Transient Voltage Response
      a. Voltage Transient Response: +/- 3% maximum while in Battery mode with resistive
         step loads from 0% to 50%, 50% to 100%, 100% to 50% and 50% to 0%. Or, +/-5%
         maximum while in Battery mode with resistive step loads from 0% to 100% or 100%
         to 0%.
   4. Transient Voltage Recovery: To within 1% of steady state output voltage within
      50 milliseconds
   5. Voltage THD:
      a. 3% Total Harmonic Distortion (THD) maximum into a 100 percent linear load
      b. 5% THD maximum into a 100% non-linear load
   6. Frequency Regulation: +/-1Hz of selected nominal frequency
   7. Overload Capacity:
      a. 150% for 10 seconds
      b. 300% for 12 cycles

2.03 CONSTRUCTION

A. Rectifier: Incoming power shall be filtered and converted to DC by a full-wave rectifier. The
   DC power shall then be processed by a high-frequency converter to supply power to the
   inverter. In the event of an AC power failure, the converter shall be supplied power without
   interruption by the battery. During normal operation, the battery shall be charged through the
   rectifier and a separate bi-directional dc-to-dc converter.

   1. Overload Capacity: The rectifier shall be capable of supplying 110% of the rated
      load for 2 minutes before switching to bypass. It shall also be capable of supplying up to
      150% of rated load for 30 seconds before transferring to bypass.
B. Inverter: The inverter shall convert the DC power at its input to regulated AC power. This regulated output shall supply power to the critical load.

   1. Frequency Control: The inverter shall synch to the line within the defined frequency limit. Outside of the defined input frequency limit, the inverter shall take over and regulate the output to within +/- 0.2 Hz.

C. Batteries: The batteries shall be sealed, lead acid, maintenance-free, high-rate discharge cells. They will be kept fully charged by the battery charger(s) in each 3kVA Power Module and optional 20 amp charger modules. They have an expected life of 200 complete full load discharge cycles when operated and maintained within specifications.

D. Battery Charger: The battery charger(s) is responsible for charging the battery and maintaining full battery charge when AC is applied to the UPS.

E. Automatic Bypass (Static bypass): The UPS shall provide an alternate path to the commercial AC or generator source in case of an overload, load fault or internal UPS failure. This input must match the output in voltage, frequency, and grounding in order to properly utilize this feature.

F. User Interface Panel: The UPS shall provide a user-friendly interface panel, which allows the user to: change operating modes, set system parameters, check alarm and inverter logs, etc. This LCD display should have four languages consisting of English, Spanish, German and French.

G. Serial (RS-232) Communication Interface: A 9-pin sub-D connector shall provide capability for communicating with manufacture-supplied software package. The UPS shall also provide signals for indication of AC-Fail; On-Battery and Low-Battery statuses.

H. (2) Communication card slots: The UPS shall provide (2) Communication card slots in the back of the UPS allowing for additional connectivity options, including SNMP/Web capabilities, etc.

I. Remote Emergency Power Off (EPO) connection: The UPS shall provide a built-in landing for field connection of a Remote Emergency Power Off circuit. Upon initiation of the REPO circuit, the UPS shall open its output relays, and disengage the battery converter, preventing power from being delivered to the attached loads.

J. On Generator connection: The UPS shall provide a built-in landing for field connection to a generator. This connection will aid the UPS in working properly with the generator.

K. On Bypass connection: The UPS shall provide a built-in landing for field connection to a maintenance bypass switch. This connection will insure the UPS is in bypass mode prior to switching to the maintenance bypass switch.

L. Input Line Cord or Hardwired to utility: The UPS can be ordered with an input line cords or for hardwired directly to a utility.

M. Receptacles or Hardwired output: The UPS can be ordered with several different types and quantities of receptacles or ordered for Hardwired output.

N. Isolation: The UPS can be ordered specially with Galvanic Isolation (split phase systems only).

* Note to Spec. Writer – Optional
STATIC UNINTERRUPTIBLE POWER SUPPLY (MODEL 9170)-SINGLE PHASE FOR 3 TO 18 KVA, SINGLE PHASE, N+X POWER AND LOGIC REDUNDANT, MODULAR, UNINTERRUPTIBLE POWER SYSTEM

SECTION 26 33 53.14

O. 20 Amp Charger Module(s): The UPS can be ordered with additional 20 amp charger module(s) for extended runtime requirements or for fast recharge requirements.

P. Rackmounting kit: The 3 and 6 slot UPS’s can be ordered with a rackmounting to allow mounting the UPS in a standard 19 inch rack.

Q. Caster kit: The 3 and 6 slot UPS’s can be order with caster kits.

R. External Matching Battery Cabinets: 6, 9 and 12 slot matching battery cabinets can be ordered for extended runtime requirements.

S. Wall Mounted Maintenance Bypass Cabinets: Wall Mounted Make Before Break or Break Before Make Bypass Cabinets can be ordered as needed for use with the UPS.

T. SNMP/Web Adaptor: Internal communication card providing network communication via SNMP protocol.

U. Relay Card: Internal card providing dry contacts for operation with AS400 systems, etc.

2.04 BATTERIES

A. Battery type: Valve Regulated Lead Acid (VRLA), minimum 3-year float service life at 25°C.

B. UPS Holdover Time (Runtime): Each UPS system, consisting of a minimum of one battery string (consisting of two battery modules) for each power module shall have a minimum holdover time of 6 minutes.

C. Extended Holdover Time (Runtime): Each UPS system shall have capability for addition of extra matching battery cabinets (in 6, 9 and 12 slot cabinet sizes) to increase the total holdover time. Please refer to price lists and data sheets for a list of runtimes with 1 to 24 stings of batteries for 3 to 18kVA systems. The battery times listed are approximate and may vary depending on load configuration and battery charge.

D. Battery recharge time:

1. Base UPS System consisting of one battery string (two battery modules) for each power module will have a recharge time of 3 hours to 80% usable capacity @ nominal line after a full load discharge.

2. UPS system with more than one battery string (two battery modules) for each power module with have a recharge time calculated by the ampere hour capacity of the total battery system divided by the nominal ampere rating of the battery charger(s) (i.e. 100AH capacity/5 amps of total charge = 20 hours of recharge) after any load discharge. The New Optional 20 Amp Charger can be used with any UPS system to improve recharge times.

E. Bus Voltage: Nominal bus voltage is 120 Vdc. This consists of two battery modules, each consisting of (5) 7.2 AH, 12 Volt batteries for a total of (10) 7.2 AH, 12 volt batteries.

F. Battery protection:

1. Short Circuit Protection: Over-current protection shall protect the batteries from all short circuit and reverse polarity fault conditions.

* Note to Spec. Writer – Optional
2. Battery Module Fusing: Internal Battery Module Fusing shall limit each module to 60 amps.

3. Over-voltage Protection: If the UPS systems battery buss voltage exceeds 150 Vdc for more than 5 seconds the UPS will disable all battery chargers and alarm a high battery condition.

4. Under-voltage Protection:
   a. Inverter cutoff voltage: Battery operation shall be terminated when the battery voltage drops to the load adaptive low battery set point. At no load the shutdown voltage should be 105 Vdc. At full load the terminal voltage of the battery should not go below 95 Vdc while in Battery Mode.
   b. Protective shutdown voltage: System current draw shall be removed from the battery when the battery voltage drops below 1.33 volts-per-cell typical.

G. Battery Management:
   1. Battery Recharge: After recharging batteries to full capacity, the charger will reduce its output to supply internal power supplies only. Continual float (trickle) charging of the battery shall not be allowed. The active battery charger states are Maintenance (no-charge), Constant-Current, and Constant-Voltage (equalize).
   2. Battery Runtime Monitoring: UPS shall monitor batteries and provide status to the end user of battery runtime via front panel, serial communications, or both. Runtime calculations to be based on load demand and analysis of battery health.
   3. Battery Health Monitoring: UPS shall periodically monitor battery health and provide warnings visually, audibly and/or serially when battery capacity falls below 80% of original capacity. Battery testing may also be user initiated via front panel or serial communications.

H. External Battery Cabinet Connection: Kit ASY-0525 must be purchased to connect each battery cabinet to the UPS.

I. Hot Swappable Battery Modules: Each Battery Module shall be User-Replaceable and Hot Swappable. All battery modules shall have a weight of 30lbs or less to insure they are User-Replaceable and Hot Swappable for one person.

J. Optional 20 Amp Charger Module: UPS shall offer an optional 20-amp charger (in the same form factor as the 3kVA Power Modules) for use with extended runtime requirements or fast recharge requirements. This charger shall be Hot Swappable and operational either within the UPS enclosure or within an external battery cabinet with an input connection to utility.

2.05 SYSTEM INPUT & OUTPUT CONNECTIONS

A. AC Input
   1. All UPS enclosures shall be capable of utilizing NEMA Input line cords for systems with outputs of less than 9kVA. NEMA L14-20P, L14-30P and 14-50P can be ordered for 3kVA systems and NEMA 15-50P can be for 6kVA systems.
   2. All UPS enclosures shall be capable of utilizing Hardwired Input
   3. UPS enclosures with Input Line Cords shall be modifiable (by trained service technicians) to Hardwired Input.
B. AC output
1. All UPS enclosures shall be capable of utilizing the NEMA receptacles listed below. The type and quantity of receptacles depends on the UPS enclosure. For example, a 3 slot UPS Enclosure could be ordered with (4) NEMA 5-15 Duplex receptacles, while a 12 slot UPS Enclosure could be ordered with (16) NEMA 5-15 Duplex receptacles or (8) 3 X NEMA 5-15 Duplex receptacles.
2. All UPS enclosures shall be capable of utilizing Hardwired Output.
3. All UPS enclosures with Receptacles shall be modifiable (by trained service technicians) to Hardwired Output.

C. Extended Battery Connector: Kit ASY-0525 must be purchased to connect each battery cabinet to the UPS.

D. Remote Emergency Power Off (EPO) connection: The UPS shall provide a built-in landing for field connection of a Remote Emergency Power Off circuit. Upon initiation of the REPO circuit, the UPS shall open its output relays, and disengage the battery converter, preventing power from being delivered to the attached loads.

E. Serial (RS-232) Communication Interface: A 9-pin sub-D connector shall provide capability for communicating with manufacture-supplied software package. The UPS shall also provide signals for indication of AC-Fail; On-Battery and Low-Battery statuses.

F. (2) Communication card slots: The UPS shall provide (2) Communication card slots in the back of the UPS allowing for additional connectivity options, including SNMP/Web capabilities, etc.

G. On Generator connection: The UPS shall provide a built-in landing for field connection to a generator. This connection will aid the UPS in working properly with the generator.

H. On Bypass connection: The UPS shall provide a built-in landing for field connection to a maintenance bypass switch. This connection will insure the UPS is in bypass mode prior to switching to the maintenance bypass switch.

2.06 USER INTERFACE

A. Front Panel Display: The UPS shall include a front panel display consisting of a 4 x 20 LCD display, three status LED's, and a six-key keypad.
1. 4 x 20 LCD display: Four Language (English, French, German and Spanish), Alphanumeric display of unit function and operating parameters. It shall be used to signify the operating state of the UPS, for indicating alarms, for changing operations control parameters and set points.
2. Three status LED's, which indicate:
   a. Alarms, with a Red LED
   b. On Battery, with a Yellow LED
   c. On Utility, with a Green LED
3. Six-Key Multifunction Keypad: UPS shall have keypad to allow user to adjust UPS parameters, view alarm and inverter logs, change UPS operational modes, turn UPS on and off.
B. Power Management Software Package: The UPS shall include serial communications interface that provides the following communication capabilities:
   1. Monitor and graphically display input and output voltage and other operating characteristics.
   2. Notify end users in the event of a power anomaly via network, E-mail or page

C. Communication Ports:
   1. (2) Internal Communication Card Slots: UPS shall have (2) Internal Communication Card Slots for additional communication capabilities, including SNMP/WEB Communication and Dry (Isolated) contact communication.

2.07 ENVIRONMENTAL CONDITIONS
A. The UPS shall meet CISPR22 Class A (EN50091-2) for Emissions and EN50091-2 (IEC610003-2 for 16 amps or less) for Harmonics.
B. Audible Noise: Less than 50 dBA (A weighted) at 1 meter from all sides in all system modes.
C. Ambient Temperature
   1. Operating: UPS 0 deg C to +40 deg C; battery 20 deg C to 30 deg C for optimum performance.
   2. Storage: UPS -40 deg C to +60 deg C; battery 0 deg C to 32 deg C
D. Relative Humidity
   1. Operating: 5 to 95% non-condensing.
   2. Storage: 5 to 95% non-condensing.
E. Altitude
   1. Operating: To 10,000 feet. Derating or reduced operating temperature range required for higher altitudes.
   2. Storage: To 40,000 feet.
F. Electrostatic Discharge: The UPS shall be able to withstand a minimum 15 kV without damage and shall not affect the critical load.

2.08 NAMEPLATES
A. Provide an engraved nameplate for each UPS.
PART 3 EXECUTION

3.01 FACTORY TESTING
   A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.02 INSTALLATION
   A. The Contractors shall install all equipment per the manufacturer's recommendations.