

**SECTION 16611 - UNINTERRUPTIBLE POWER SUPPLY SYSTEMS  
FOR INDOOR INSTALLATION**

**City of San Diego, CWP Guidelines**

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NTS: This specification applies to a 3.5 to 18 KVA UPS for indoor installation for support of solid-state electronics and computer-based systems in indoor locations in non-corrosive environments. This specification is for industrial-grade true on-line UPS that provide 100% isolation from incoming power using a full rectifier-inverter configuration. Other types of UPS, including standby and ferroresonant transformer technology, are less costly but have proven to be unreliable in the harsh environment of MWW plants. Enter specific kVA and input/output voltage requirements for specific UPS systems in the Equipment Table in Appendix A.

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**PART 1 - GENERAL**

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing and installing 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. This specification applies to a 3.5 to 18 KVA UPS.

1.2 RELATED SECTIONS

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.

Section 16050 Basic Electrical Material and Methods

1.3 CODES

- A. The WORK of this Section shall comply with the current editions of the following codes as adopted by the City of San Diego Municipal Code:

National Electrical Code (NEC) NFPA 70

1.4 STANDARDS

- A. The UPS shall be designed in accordance with the applicable sections of the current revision of the following documents. Where a conflict arises between these documents and statements made herein, the statements in this specification shall govern.

ANSI C62.41-1991 (IEEE 587),  
Category A & B

Recommended Practice on Surge Protection

## 1.5 SHOP DRAWINGS AND SAMPLES

- A. The following shall be submitted in compliance with Section 01300:
1. The CONTRACTOR shall submit sufficient information to indicate the scope and quality of the UPS system installation.
  2. Block diagram showing system relationships of major components and quantities and interconnecting cable requirements.
  3. Equipment outlet devices and special mounting details.
  4. Wiring diagrams showing terminal identification for factory, as well as field-installed, wiring.
  5. Catalog literature.
  6. Documentation of manufacturer's qualifications, including contact names, addresses, and telephone numbers.

## 1.6 OWNER'S MANUAL

- A. The specified UPS system shall be supplied with OWNER'S MANUAL. The OWNER'S MANUAL shall include installation drawings and instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step by step operating procedures, and routine maintenance guidelines.

## 1.7 WARRANTY

- A. The UPS manufacturer shall warrant the UPS, including batteries, against defects in materials and workmanship for one (1) year. The CONTRACTOR shall provide an extended warranty for all parts and on-site labor for [1] [2] [3] additional years.

## 1.8 QUALITY ASSURANCE

- A. **Manufacturer Qualifications:** The manufacturer of the UPS systems shall be a reputable manufacturer regularly engaged in manufacturing and supporting UPS systems for industrial and commercial facilities.

## PART 2 – PRODUCTS

### 2.1 GENERAL

- A. All materials and components making up the UPS shall be new, of current manufacture, and shall not have been in prior service except as required during factory testing. The UPS shall be constructed of replaceable subassemblies. All active electronic devices shall be solid-state.
- B. Single-Phase UPS shall be Liebert UPStation S, **or equal**.

### 2.2 SYSTEM DESCRIPTION

A. **Modes of Operation:** The UPS shall be designed to operate as a true on-line system in the following modes:

1. Normal - The critical AC load is continuously supplied by the UPS inverter. The input converter derives power from a utility AC source and supplies DC power to the inverter. The battery charger shall maintain a float-charge on the battery.
2. Back-up - Upon failure of utility AC power, the critical AC load is supplied by the inverter, which obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the utility AC source.
3. Recharge - Upon restoration of utility AC power, after a utility AC power outage, the input converter shall automatically restart and resume supplying power to the inverter. Also the battery charger shall recharge the battery.
4. Automatic Restart - Upon restoration of utility AC power, after a utility AC power outage and complete battery discharge, the UPS shall automatically restart and resume supplying power to the critical load. Also the battery charger shall automatically recharge the battery.

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NTS: The following specifies a bypass to line power internal to the UPS. An external bypass switch is also required.

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B. **Bypass:** The bypass shall provide an alternate path for power to the critical load that shall be capable of operating in the following manner:

1. Automatic - In the event of an internal failure or should the inverter overload capacity be exceeded, the UPS shall perform an automatic transfer of the critical AC load from the inverter to the bypass source.
2. Manual - Should the UPS need to be taken out of service for limited maintenance or repair, manual activation of the bypass shall cause an immediate transfer of the critical AC load from the inverter to the bypass source. The input converter, inverter, and battery charging operations shall be inhibited until the switch is moved back to the "UPS" position and the unit restarted.

C. **Maintenance Bypass:** The plug & play (3.5 - 6kVA) units shall include provisions to allow for repair of the unit or replacement of batteries without interruption of power to the load.

## 2.3 PERFORMANCE REQUIREMENTS

### A. System

1. **Isolation:** Input to output isolation shall be provided when operating in the UPS mode.
2. **Remote Emergency Power Off:** The UPS shall provide provisions for remote emergency power off capability.

### B. AC Input to UPS

1. **Voltage Configuration:** 176 to 264 VAC, single-phase, 3-wire-plus-ground, or 208/120 VAC three-phase, 4-wire as shown in the Appendix..
2. **Frequency:** 45 to 65 Hz.
3. **Input Current Distortion:** 5% total harmonic distortion (THD) maximum at full load. If three phase input is utilized (available on 8-18 kVA units), maximum THD shall not exceed 30%.
4. **Input Power Factor:** 0.98 lagging minimum from 50% to 100% rated 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.

### C. AC Output, UPS Inverter

1. **Voltage Configuration:** 208/120 VAC, single-phase, 3-wire-plus-ground. Field programmable to 240/120 VAC, 230/115 VAC, 220/127 VAC, 220/110 VAC, 200/100 VAC. The UPS can also be ordered to supply line to neutral voltages of 240 VAC, 230 VAC, 220 VAC.
2. **Voltage Regulation:**  $\pm 2\%$  steady state.
3. **Frequency Regulation:** Field selectable 50 Hz or 60 Hz,  $\pm 0.01\%$ .
4. **Frequency Slew Rate:** 3.0 Hertz per second maximum. Field selectable from 0.3, 0.5, 1, 2, or 3 Hz per second from the liquid crystal display (LCD).
5. **Bypass Frequency Synchronization Range:**  $\pm 1.0$  Hertz . Field selectable from  $\pm 0.1$  Hz to  $\pm 5.0$  Hz, in 0.1 Hz increments from the LCD display.
6. **Voltage Distortion:** 3% THD maximum into a 100% linear load, 5% THD maximum into a 100% non-linear load with crest factor ratio of 3:1.
7. **Load Power Factor Range:** 0.5 lagging to 0.5 leading.
8. **Output Power Rating:** Rated kVA at: 0.8 lagging power factor for 3.5 and 4.5 kVA models; 0.67-0.77 lagging power factor for 6.0 kVA models depending upon output voltage; 0.75 lagging power factor for 8.0 and 10.0 kVA models; 0.7 lagging power factor for 12.0, 15.0 and 18.0 kVA models.
9. **Inverter Overload Capability:** 105% continuously, 125% for 10 minutes, 150% for 10 seconds, 250% for 12 cycles. For units with the bypass option installed, the load shall be transferred to bypass when any of the above conditions are exceeded.
10. **Inverter Output Voltage Adjustment:**  $\pm 5\%$  manual adjustment from the LCD by qualified service personnel.

11. **Voltage Transient Response:**  $\pm 5\%$  maximum for any load step up to and including 100% of the UPS rating.
12. **Transient Recovery Time:** To within 1% of steady state output voltage within 50 milliseconds.

D. **Batteries**

1. **Internal Battery:** The battery shall consist of sealed, valve regulated, reduced maintenance, lead acid cells. Flame retardant batteries shall be provided, which render the UPS suitable for installation inside a computer room per requirements of UL Standard 1778.
  2. **Reserve Time:** The UPS shall contain provisions to interface with an external matching battery cabinet to extend reserve time capabilities (with ambient temperature between 20 and 30 deg C). The UPS shall contain a battery internal battery system to provide reserve time of [30 minutes] [        ].
- E. **Battery Recharge:** To prolong battery life, the UPS shall contain temperature-compensated battery charging. Recharge time shall be twenty (20) times discharge time to 95% capacity. (Field selectable to ten (10) times discharge time to 95% capacity from the LCD display.)

2.4 ENVIRONMENTAL CONDITIONS

A. **Ambient Temperature**

Operating: UPS 0°C to +40°C; battery 20°C to 30°C for optimum performance.  
Storage: UPS -30°C to +70°C; battery 0°C to 32°C for maximum 6 months.

B. **Relative Humidity**

Operating: 0 to 95% non-condensing.  
Storage: 0 to 95% non-condensing.

C. **Altitude**

**Operating:** To 4,000 feet. Derating or reduced operating temperature range required for higher altitudes.

**Storage:** To 50,000 feet.

- D. **Audible Noise:** Noise generated by the UPS during normal operation shall not exceed 55 dBA measured at 1 meter from the surface of the UPS.

- E. **Electrostatic Discharge:** The UPS shall be able to withstand a minimum 15 kV without damage and shall not affect the critical load.

2.5 CABINET

- A. The UPS unit comprised of: input converter, battery charger, inverter, bypass, and battery consisting of the appropriate number of sealed battery cells, shall be housed in a single free-

standing NEMA type 1 enclosure and meets the requirements of IP20. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer's standard color. Casters and leveling feet shall be provided. UPS cabinet dimensions shall not exceed [select one: {9 inches wide, 31 inches deep, and 29 inches high (for 3.5 - 6.0 kVA units)}; {18 inches wide, 27 inches deep, and 29 inches high (for 8.0 - 12.0 kVA units)}; {27 inches wide, 27 inches deep, and 29 inches high (for 15.0 - 18.0 kVA units)}].

## 2.6 COOLING

- A. The UPS shall be forced air cooled by internally mounted, variable speed fans to reduce audible noise.

## 2.7 COMPONENTS

### A. Input Converter

1. **General:** Incoming AC power shall be converted to a regulated DC output by the input converter for supplying DC power to the inverter. The input converter shall provide input power factor and input current distortion correction. The input converter shall provide input to output isolation by means of a high frequency transformer.
2. **AC Input Current Limit:** The input converter shall be provided with AC input current limiting whereby the maximum input current shall be limited to 125% of the full load input current rating.
3. **Input Protection:** The UPS shall have built-in protection against undervoltage, overcurrent, and overvoltage conditions including low-energy surges introduced on the primary AC source and the bypass source. The UPS shall sustain input surges without damage per criteria listed in ANSI C62.41-1980 (IEEE 587). The UPS shall contain [ select one: {input fuses (3.5-6.0 kVA) } - or - {an input circuit breaker (8.0-18.0 kVA)} ] sized to supply full rated load and to recharge the battery at the same time.
4. **Battery Recharge:** To prolong battery life, the UPS shall contain two battery recharge rates, and charging voltage shall be temperature-compensated. The "turbo" mode of recharge shall be capable of recharging the battery to 95% capacity within ten (10) times the discharge time of the battery. The "slow" mode of recharge shall be capable of recharging the battery to 95% capacity within twenty (20) times the discharge time.
5. **Charger Output Filter:** The battery charger shall have an output filter to minimize ripple current into the battery. Under no conditions shall ripple current into the battery exceed 2% root mean square (RMS).
6. **Overvoltage Protection:** There shall be DC overvoltage protection so that if the DC voltage exceeds the pre-set limit, the UPS shall shutdown automatically and the critical load shall be transferred to bypass.

### B. Inverter

1. **General:** The UPS shall contain two independently controlled inverters and shall be pulse-width-modulated (PWM) design capable of providing the specified AC output. The inverters

shall convert DC power from the input converter output, or the battery, into precise regulated sine wave AC power for supporting the critical AC load.

2. **Overload:** The inverter shall be capable of supplying current and voltage for overloads exceeding 100% and up to 150% of full load current. A visual indicator and audible alarm shall indicate overload operation. For greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components. The inverter shall be self-protecting against any magnitude of connected output overload. Inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective fuses. For units supplied with the bypass option, the load shall be transferred to bypass when any of the above conditions are exceeded.

3. **Inverter DC Protection:** The inverter shall be protected by the following DC shutdown levels:

DC Overvoltage Shutdown

DC Undervoltage Shutdown (End of Discharge)

DC Undervoltage Warning (Low Battery Reserve) shall be factory set at 2 minutes and user adjustable from 1 to 99 minutes from the LCD display.

4. **Inverter Output Voltage Adjustment:** The inverter shall employ a manual control to adjust the output voltage from  $\pm 5\%$  of the nominal value from the LCD by qualified service personnel.

5. **Output Frequency:** The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall hold the inverter output frequency to  $\pm 0.01\%$  for steady state and transient conditions. For units equipped with a bypass, the inverter shall track the bypass continuously providing the bypass source maintains a frequency within the user selected synchronization range. If the bypass source fails to remain within the selected range, the inverter shall revert to the internal oscillator.

6. **Output Protection:** The UPS inverter shall employ electronic current limiting and an output circuit breaker. The main output breaker shall be rated for a minimum 10kAIC.

7. **Battery Over Discharge Protection:** To prevent battery damage from over discharging, the UPS control logic shall automatically raise the shutdown voltage set point as discharge time increases beyond fifteen (15) minutes.

### C. Display and Controls

1. **General:** The UPS shall be provided with a microprocessor based unit status display and controls section designed for convenient and reliable user operation. The monitoring functions such as metering, status and alarms shall be displayed on a four line by sixteen character alpha-numeric LCD display. Additional features of the LCD monitoring system shall include:

- a. Menu-driven display with text format
- b. Real time clock (time and date)
- c. Alarm history with time and date stamp
- d. Battery backed-up memory

2. **Metering:** The following parameters shall be displayed:
  - a. Input AC voltage line-to-line and line-to-neutral for each phase
  - b. Input AC current for each phase
  - c. Input frequency
  - d. Battery voltage
  - e. Battery charge/discharge current
  - f. Output AC voltage line-to-line and line-to-neutral for each phase
  - g. Output AC current for each phase
  - h. Output frequency
  - i. Percent of rated load being supplied by the UPS
  - j. Output kVA and kW for each phase
  - k. Battery time remaining during battery operation
  - l. Operating temperature of input converter, inverter, and internal battery
  
3. **Status Messages:** The following UPS status messages shall be displayed:
  - a. Normal operation
  - b. UPS on battery
  - c. System shutdown
  - d. Start up sequence aborted
  - e. Battery test enabled/disabled
  - f. System time set by operator
  - g. Load on bypass
  
4. **Alarm Messages:** The following alarm messages shall be displayed and an audible alarm shall be provided and activated by any of the following alarm conditions.:
  - a. Input power out of tolerance
  - b. UPS output not synchronized to input
  - c. Output undervoltage
  - d. Input power single phased
  - e. Output overvoltage
  - f. Incorrect input frequency
  - g. Output overcurrent
  - h. Input in current limit charging batteries
  - i. Overcurrent detected in inverter
  - j. Charger failure
  - k. Battery charger problem
  - l. Battery failed test
  - m. Critical power supply failure
  - n. External shutdown
  - o. Low battery shutdown
  - p. Low battery warning
  - q. DC bus overvoltage
  - r. System shutdown due to overload
  - s. Inverter failure
  - t. System shutdown: loss of control power
  - u. Over temperature shutdown



v. System output overloaded

5. **Controls:** UPS start-up and shutdown operations shall be accomplished via the front LCD display panel. An advisory display and menu-driven user prompts shall be provided to guide the operator through system operation without the use of additional manuals. Push buttons shall be provided to display the status of the UPS and to test and reset visual and audible alarms. The UPS shall contain an output circuit breaker and a manual bypass switch as additional user controls, that shall be located on the rear of the unit.

2.8 ON-LINE BATTERY TEST

- A. The UPS shall be provided with an on-line battery test feature. The test shall ensure the capability of the battery to supply power to the inverter while the load is supplied power in the normal mode. If the battery fails the test, the UPS shall display a warning message and sound an audible alarm. The battery test feature shall have the following user selectable options, accessible from the LCD display:
1. DC bus voltage threshold (pass/fail value)
  2. Enable/disable test

2.9 REMOTE EMERGENCY POWER OFF

- A. Remote emergency power off capabilities shall be provided. A connector shall be provided for connection of a normally open contact supplied by the user.

2.10 BYPASS

- A. **General:** A bypass circuit shall be provided as an integral part of the UPS. The bypass shall have an overload rating of 300% rated load for 10 cycles and 1000% for sub-cycle fault clearing. The bypass control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit shall provide a transfer of the load to the bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS.
- B. **Automatic Transfers:** The transfer control logic shall automatically activate the bypass, transferring the critical AC load to the bypass source, after the transfer logic senses one of the following conditions:
1. Inverter overload capacity exceeded
  2. Critical AC load overvoltage or undervoltage
  3. UPS fault condition

For inverter overload conditions, the transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if one of the following conditions exists:

1. Inverter/Bypass voltage difference exceeding preset limits (+10%, to -15% of nominal)
2. Bypass frequency out of preset limits (+/- 1.0 Hz, field selectable from +/- 0.1 Hz to +/- 5.0 Hz, in 0.1 Hz increments)

For UPS fault or output over/under voltage conditions, the transfer control logic shall not inhibit automatic transfers of the critical load to the bypass source.

C. **Automatic Retransfers:** Retransfer of the critical AC load from the bypass source to the inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists:

1. Bypass out-of-synchronization range with inverter output
2. Overload condition exists in excess of inverter full load rating
3. UPS fault condition present

D. **Manual Transfer:** Manual operation of the bypass shall directly connect the critical load to the input AC power source, bypassing the input converter, battery charger, inverter, and battery.

## 2.11 INTERNAL BATTERY

A. Sealed, flame retardant, valve regulated, low maintenance, lead acid batteries shall be used as a stored-energy source for the specified UPS system. The battery shall be housed internal to the UPS cabinet, and sized to support the inverter at rated load and power factor, in an ambient temperature between 20° and 30° C, for a minimum of 10 minutes reserve time. The expected life of the battery shall be 5 years or a minimum 250 complete discharge cycles.

## 2.12 OUTPUT DISTRIBUTION

A. An output power distribution module shall be utilized for input and output connections on the 3.6-6 kVA units. The module shall contain maintenance bypass capability as a standard feature with no additional wiring.

## 2.13 ACCESSORIES

### A. **Communication Interface Boards**

1. **General:** Communication interfaces shall be provided on field-installable, plug-in printed circuit boards. Two interface slots shall be provided to allow multiple communication capabilities.
2. **RS-232 Interface Board:** The RS-232 interface board shall facilitate communication interfaces for the following:
  - a. RS-232 communication
  - b. External Modem
  - c. Computer/LAN interface
  - d. Customer-configured relay interface
3. **RS-232 Interface Port:** The RS-232 interface port shall transmit UPS status for display at a remote terminal, computer, or external modem, via a DB25 connector. The remote display shall mimic the information provided on the LCD monitoring and control panel, including status of all UPS alarms, input voltage, output voltage, percentage load, and battery time remaining.

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NTS: This software automatically notifies the operating system when there is a power failure or low battery, via a serial port (RS-232) interface. Ensure that a spare serial port exists on the computer, that the operating system supports the software, and that other applications such as SCADA software, do not conflict. Some major UPS manufacturers now provide versions for most variations of UNIX, and versions that support simple network management protocol (SNMP) system software.

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4. **Computer/LAN Interface Kits:** Computer/LAN interface kits shall consist of a ten (10) foot communication cable and software. Two separate software kits shall be available to operate in the following manner:
  - a. Computer/LAN shutdown software shall run as a background task on the computer while monitoring the UPS. The software shall perform an unattended orderly shutdown of the computer operating system, when signaled by the UPS of a power failure or low battery condition.
  - b. Power Surveillance software shall run as a background task on the computer while monitoring the UPS. The Power Surveillance software shall incorporate the shutdown capabilities of Computer/LAN shutdown software (except DOS) and shall also provide UPS monitoring and control capabilities from a stand alone computer.
5. Contacts rated for 1.0 amp at 30 volts AC or DC shall be provided to indicate a change of status of each of the following conditions:
  - a. On UPS
  - b. On Battery
  - c. Low Battery
  - d. On Bypass

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NTS: If software monitoring is not feasible provide as a minimum a relay input to the DCS or PLC for alarms. The relay interface is normally an option with most manufacturers, but it is not expensive and is highly recommended even if software monitoring is used.

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- B. **Customer-Configured Relay Interface:** An interface board shall be provided that allows the customer to have UPS status/alarm conditions available for remote panel monitoring via relay contact closures. Programming shall be done via the LCD display, as directed by the CONSTRUCTION MANAGER.

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NTS: For larger networks with SNMP-compliant network components and network management software, and for larger UPSs, this option is superior to the simple serial link because it provides more complete monitoring and allows remote control.

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1. **Simple Network Management Protocol Interface Board:**

- a. The SNMP interface board (agent) shall be provided to allow communication between the UPS and any Network Management System (NMS). The SNMP agent shall be installed in the UPS cabinet, external "proxy" agent configurations shall not be allowed. The SNMP interface shall be available in Ethernet TCP/IP message format to permit direct connection to the network. Ethernet connection shall be Unshielded Twisted Pair (UTP). The SNMP agent shall include software that contains the standard library of commands in the Management Information Base (MIB). An extended MIB shall be available to enable the user access to create custom UPS variable interface screens. SNMP Snap-in interfaces shall be available for major NOS platforms.
- b. The SNMP connection shall allow multiple network managers to both monitor the status and control many operational features of the UPS. Monitoring data supplied by the UPS shall include but not be limited to the input, output, and battery voltages and currents, battery condition, battery reserve time remaining, internal component temperatures, UPS loading, and UPS status and alarm indicators. UPS operational features shall include but not be limited to setting UPS operating parameters, turning the UPS off and on, and manually initiating battery tests.

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NTS: Specify load modules and receptacle in Table 1 of Appendix A

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2. **Output Load Modules:** Output load modules (maximum of 8) shall be available for field addition to the optional configurable distribution module. Each load module shall include user specified receptacle(s), LED indicator lamp, and circuit breaker protection. The following load modules shall be provided:

Receptacle	Voltage (configuration)	Circuit Breaker
5-15R2	120 (L-N-G)	15A, 2 pole
L5-15R1	120 (L-N-G)	15A, 1 pole
6-15R1	208 or 240 (L-L-G)	15A, 2 pole
L6-15R1	208 or 240 (L-L-G)	15A, 2 pole
L5-15R2	120 (L-N-G)	15A, 2 pole
5-20R2	120 (L-N-G)	20A, 2 pole
L5-20R1	120 (L-N-G)	20A, 1 pole
L6-20R1	208 or 240 (L-L-G)	20A, 2 pole
L14-20R1	208/120 or 240/120 (L-L-N-G)	30A, 1 pole
L5-30R1	120 (L-N-G)	30A, 1 pole
L6-30R1	208 or 240 (L-L-G)	30A, 2 pole
L-14-30R1	208/120 or 240/120 (L-L-N-G)	30A, 2 pole
Hardwire (15A)	208/120 or 240/120 (L-L-N-G)	15A, 2 pole

Hardwire (20A)	208/120 or 240/120 (L-L-N-G)	20A, 2 pole
Hardwire (30A)	208/120 or 240/120 (L-L-N-G)	Not Required

- C. **External Battery Cabinet:** External battery cabinets shall be provided for the UPS. The battery cabinet shall be used in parallel with the internal battery for extended power outage reserve time. The battery cabinet shall contain (1 or 2) strings of flame retardant, sealed, valve regulated, low maintenance, lead acid cells, housed in a separate cabinet that matches the UPS cabinet styling. Inter-cabinet wiring with mating connectors shall be supplied with the external battery cabinet (for 3.5 - 12 kVA only). The external battery cabinet shall contain 2 fuses per string, to provide individual string protection and isolation. The external battery cabinet shall increase power outage reserve time to [30] [60] [120] [ ] minutes at full load, when operating in an ambient temperature between 20 and 30 deg C.
- D. **Maintenance Bypass:** 3.5 - 6 kVA units shall include an output power distribution module which contains a rotary maintenance bypass switch to provide complete “wrap around” protection. For units larger than 6 kVA, provide a wall-mounted maintenance bypass switch and cabinet. The maintenance bypass cabinet controls shall be located behind a lockable front panel to provide security. An auxiliary contact shall be provided to indicate maintenance bypass or UPS operation [to the PLC] [to the DCS].

### PART 3 -- EXECUTION

#### 3.1 GENERAL

- A. The UPS shall be installed in accordance with the equipment manufacturer’s installation instructions.
- B. **Detailed Requirements**
1. The CONTRACTOR shall receive, store, and assemble all sections of the UPS to form complete units. The CONTRACTOR shall make all internal wiring interconnections as required for complete assembly of each UPS. Where wiring connectors are not supplied by the manufacturer the CONTRACTOR shall furnish the connectors required to complete internal wiring terminations.
  2. The CONTRACTOR shall take all necessary precautions to eliminate moisture and foreign material from the equipment at all times during storage and installation. Special care shall be taken to prevent corrosion of and damage to the UPS.
  3. Each UPS shall be set level and plumb on a raised concrete floor pad as indicated.

#### 3.2 FIELD QUALITY CONTROL

- A. The following inspections and test procedures shall be performed by factory trained field service personnel during the UPS start-up.
1. Visual Inspection
  2. Inspect equipment for signs of shipping or installation damage
  3. Verify installation per drawings
  4. Inspect cabinets for foreign objects

5. Verify neutral and ground conductors are properly sized and configured
6. Inspect battery cases
7. Inspect battery for proper polarity
8. Verify all printed circuit boards are configured properly

**B. Mechanical Inspection**

1. Check all control wiring connections for tightness
2. Check all power wiring connections for tightness
3. Check all terminal screws, nuts, and/or spade lugs for tightness

**C. Electrical Inspection**

1. Check all fuses for continuity
2. Confirm input voltage and phase rotation is correct
3. Verify control transformer connections are correct for voltages being used
4. Assure connection and voltage of the battery string(s)

**3.3 UNIT START-UP AND SITE TESTING**

- A. Site testing shall be provided by the manufacturer's field service personnel if requested. Site testing shall consist of a complete test of the UPS system and the associated accessories supplied by the manufacturer. A partial battery discharge test shall be provided as part of the standard start-up procedure. The test results shall be documented, signed, and dated for future reference.

**3.4 MANUFACTURER'S FIELD SERVICE**

**A. UPS Maintenance Training**

1. Provide [on-site] [at local representative's facility] [elsewhere] maintenance training courses given by the UPS manufacturer. This training is in addition to the basic operator training conducted as a part of the system start-up. Provide a minimum of [4 hours] [1 day] [\_\_hours] of training for [\_\_] sessions for a minimum of [\_\_] students per session.
2. The training course shall cover UPS theory, location of subassemblies, safety, battery considerations and UPS operational procedures. The course shall include AC to DC conversion and DC to AC inversion techniques as well as control, metering, and feedback circuits to the Printed Circuit Board (PCB) level. Troubleshooting and fault isolation using alarm information and internal self-diagnostics shall be stressed.

Appendix A

**Table 1**  
**UPS Systems To Be Provided**

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NTS: The following are example data. Modify table according to the requirements. If CONTRACTOR is responsible for sizing the UPS to meet a standby power time requirement, delete kVA and substitute time required.

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UPS Tag or Location	kVA	Input Voltage	Output Voltage	Output Load Module/ Receptacle	Option
60-UPS-01		120V single-phase	120V single-phase		

**\*\*END OF SECTION\*\***