Bid specifications Smart-UPS VT

SPECIFICATIONS FOR
3x208/208-120 Solution
3x480/208-120 Solution
20kVA-30kVA UPS

PART 1 - GENERAL

1.1 SUMMARY

A. This specification describes the operation and functionality of a continuous duty, three-phase, solid-state, static Uninterruptible Power System (UPS) hereafter referred to as the UPS. The UPS shall contain a full rated input rectifier / boost converter (hereafter referred to as Input Converter), output inverter, and 10% battery charging circuit. The system shall also contain a continuous duty bypass static switch, internal mechanical bypass switch, rear mounted PDU, removable hot swappable battery plant, LCD interface display and optional input transformer. All of the above system components are housed in a single standard, 24 inch wide, 42 inch deep, 42U high equipment rack.

B. In addition, this specification describes the performance, functionality, and design of the power distribution section of the UPS. In addition this specification also includes multi-conductor overhead distribution, rack level power management products, the Battery System and connectivity solutions including complete InfraStruXure™ system management solutions.

C. The UPS and associated equipment shall operate in conjunction with a primary power supply and an output distribution section to provide quality uninterrupted power and distribution for mission critical, electronic equipment load. The entire system shall bear the UL 60950 listing as a complete product solution.

D. All programming and miscellaneous components for a fully operational system as described in this specification shall be available as part of the System.

1.2 STANDARDS

A. UL 1778 Uninterruptible Power Supply Equipment

B. UL 60950 Information Technology Equipment

C. IEC61000-4-5, EN50091-2 Surge

D. IEC62040-2, EN50091-2 EMC/EMI/RFI

E. EN62040-1-1, EN60950 Safety

F. Where applicable, the UPS shall also be designed in accordance with publications from the following organizations and committees

1. NFPA- National Fire Protection Associations

2. NEMA - National Electrical Manufacturers Association

3. OSHA - Occupational Safety and Health Administration

G. IEEE 519-1992 Standard Practices and Requirements for Harmonic Control in Electrical Power Systems.

H. ISO 9001

I. ISO 14001

1.3 UPS MODES OF OPERATION

A. Normal: The input converter and output inverter shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

B. Battery: Upon failure of the AC input source, the critical load shall continue being supplied by the output inverter, which shall derive its power from the battery system. There shall be no interruption in power to the critical load during both transfers to battery operation and retransfers from battery to normal operation.

C. Static Bypass: The static bypass shall be used to provide transfer of critical load from the Inverter output to the bypass source. This transfer, along with its retransfer, shall take place with no power interruption to the critical load. In the event of an emergency, this transfer shall be an automatic function. The UPS will be capable of charging the batteries while in static bypass.

D. Internal Mechanical Bypass: As a standard feature, the UPS shall be equipped with an internal, make before break, bypass switch. This switch shall mechanically bypass the UPS for times where maintenance is required.

1.4 SUBMITTALS

A. Proposal Submittals:

1. As bid system bill of materials.

2. Product catalog sheets or equipment brochures.

3. Product guide specifications.

4. System single-line operation diagram.

5. Installation information, including weights and dimensions.

6. Information about terminal locations for power and control connections.

7. Drawings and details for requested optional accessories.

B. Delivery Submittals:

1. Installation manual, which includes instructions for storage, handling, examination, preparation, installation, and start-up of UPS.

2. User manual, which includes operating instructions.

3. As built equipment drawings

4. InfraStruXure™ Welcome Package.

PART 2 – PRODUCT

2.1 DESIGN REQUIREMENTS

A. The UPS shall be sized for _____ kVA and _____ kW load.

B. The UPS battery shall be sized for _____ at a Power Factor of_____ for _____ minutes.

2.2 SYSTEM CHARACTERISTICS

A. System Capacity: The system shall be rated in the following sizes:

1. 20kVA /16kW
2. 30kVA /24kW

B. Input:

1. AC Input Nominal Voltage: 208V, 3 Phase, 4 wire plus ground, 60 Hz or 480V, 3 phase 3 wire plus ground, 60Hz.

2. AC Input Voltage Window: $^{+}/_{-}$15% of nominal (while providing nominal charging to the battery system).

3. Short Circuit Withstand Rating: 30,000 Symmetrical Amperes

4. Maximum Frequency Range: 40-70Hz

5. Input Power Factor:
   a. .98 for loads greater than 50%

6. Input Current Distortion *with no additional filters*:

   a. < 5% at 100% load

7. Soft-Start: Shall be linear from 0-100% input current and shall not exhibit inrush. This shall take place over a 15 second time period when transferring from battery operation to mains operation

C. UPS Output:

1. AC Output Nominal Output: 208V, 3 Phase, 4 wire plus ground, 60 Hz.

2. AC Output Voltage Regulation: $^{+}$/- 1% For 100 % Linear or Nonlinear Load,
   $^{+}$/- 5% maximum for 100% linear load step

3. Voltage Transient Recovery within <50 milliseconds

4. Output Voltage Harmonic Distortion:
   <2% THD maximum for a 100% linear load
   <5% THD maximum for a 100% non-linear load

5. Phase Angle Displacement:

   a. 120 degrees $^{+}$/. 1 degree for balanced load
   b. 120 degrees $^{+}$/. 1 degrees for 50% imbalanced load
   c. 120 degrees $^{+}$/. 3 degrees for 100% imbalanced load

6. Overload Rating:

   a. Normal Operation:

      1) 150% for 30 seconds
      2) 100% continuous

   b. Bypass Operation:

      1) 110% continuous

7. System AC-AC Efficiency: >98% for loads higher than 50% of rated system capacity

10. Output Power Factor Rating: .5 leading to .5 lagging.

2.3 ENVIRONMENTAL

A. Storage Ambient Temperature: -58°F to 122°F (-50°C to 50°C).

B. Operating Ambient Temperature: +32°F to 104°F (0°C to 40°C). (77°F is ideal for most battery types).

C. Relative Humidity: 0 to 95% Non-condensing

D. Altitude: Maximum installation with no derating of the UPS output shall be 3280 feet (1000m) above sea level. At higher altitudes the following derating shall apply:
   a. 1500 m derating factor of .95
   b. 2000 m derating factor of .91
   c. 2500 m derating factor of .86

E. Audible Noise: The UPS shall not produce audible noise at a distance of 1m (39") in excess of the following:

   1. 20-30kVA 67dBA

2.4 INPUT POWER CONVERTER

A. The input power converters of the system shall constantly control the power imported from the mains input of the system, to provide the necessary UPS power for precise regulation of the DC bus voltage, battery charging, and Main Inverter regulated output power..

B. Input Current Total Harmonic Distortion: The input current THD_I shall be held to 5% or less at full system, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting loads of both a linear or non-linear type. This shall be accomplished with no additional filters, magnetic devices, or other components.

C. Soft-Start Operation: As a standard feature, the UPS shall contain soft-start functionality, capable of limiting the input current from 0-100% of the nominal input over a default 15 second period, when returning to the AC utility source from battery operation. The change in current over the change in time shall take place in a linear manner throughout the entire operation. (di/dt= constant)

D. Magnetization Inrush Current: The UPS shall exhibit 0 inrush current as a standard product. If provided with an optional isolation transformer, inrush shall be limited to 6 times the nominal input current of the transformer.

E. Input Current Limit:

1. The system input current limit, shall be designed to provide 100% load will fully charging the batteries at 10% of the system rating. The system shall be capable of this with up to a $^{+}/_{-}$15% variation of the nominal input voltage.

F. Charging:

1. The battery charging shall keep the DC bus float voltage of +/- 220v, +/-1%

2. The battery charging circuit shall contain a temperature compensation circuit, which will regulate the battery charging to optimize battery life.

3. The battery charging circuit shall remain active when in Static Bypass and in Normal Operation.

4. Battery Charge Current Limit: The UPS shall be capable of limiting the energy sourced from the mains for purposes of battery charging. As a default setting, the battery charge energy will be set to 100% of its nominal value. When signaled by a dry contact, (such as from an emergency generator) the UPS shall be capable of limiting the battery charge energy taken from the mains. This shall take place in user selectable increments of 75%, 50%, 25%, 10% and 0% of the nominal charge power. The selection shall be made from the UPS front panel display/control unit.

G. Back-feed Protection: The logic controlled input contactor shall provide the back-feed protection required by UL1778.

2.5 OUTPUT INVERTER

A. The UPS output inverter shall constantly recreate the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT driven power converters. In both normal operation and battery operation, the output inverters shall create an output voltage independent of the mains input voltage. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output inverters.

B. Overload Capability: Steady-state overload conditions of up to 150% of system capacity shall be sustained by the inverter for 30 seconds in normal and battery operation. Overloads of 125% shall be sustainable by the inverter for up to 60 seconds. Should overloads persist past the time limitation, the critical load will be switched to the automatic static bypass output of the UPS.

C. Output Contactor: The output inverter shall be provided with an output mechanical contactor to provide physical isolation of the inverter from the critical bus. With this feature a failed inverter shall be removed from the critical bus.

H. Battery Protection: The inverter shall be provided with monitoring and control circuits to limit the level of discharge on the battery system.

I.

2.6 STATIC BYPASS

A. As part of the UPS, a system static bypass switch shall be provided. The system static bypass shall provide no break transfer of the critical load from the Inverter output to the static bypass input source during times where maintenance is required or the inverter can not support the critical bus. Such times may be due to prolonged or severe overloads or UPS failure.

B. The design of the static switch power path shall consist of Silicon Controlled Rectifiers (SCR) with a continuous duty rating of 110% of the UPS output rating.

C. Automatic Transfers: An automatic transfer of load to static bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from static bypass back to normal operation shall take place when the overload condition is removed from the critical bus output of the system. Automatic transfers of load to static bypass shall also take place if for any reason the UPS cannot support the critical bus.

D. Manual Transfers: Manually initiated transfers to and from static bypass shall be initiated through the UPS display interface.

E. Overloads: The static bypass shall be rated and capable of handling overloads equal to or less than 110% of the rated system output continuously. For instantaneous overloads caused by inrush current from magnetic devices or short circuit conditions, the static bypass shall be capable of sustaining overloads of 800% of system capacity for periods of up to 500 milliseconds.

F. System Protection:

As a requirement of UL1778, back-feed protection in the static bypass circuit shall also be incorporated in the system design. To achieve back-feed protection, a mechanical contactor in series with the bypass SCR(s) shall be controlled by the UPS/static switch, to open immediately upon sensing a condition where back-feeding of the static switch by any source connected to the critical output bus of the system is occurring. One such condition could be a result of a shorted SCR.

G. Dual Feed

For purposes of increased reliability, the static bypass shall be capable of being fed from a separate feed from the input power converter.

2.7 DISPLAY AND CONTROLS

A. Display Unit: A microprocessor controlled display unit shall be located on the front of the system. The display shall consist of an alphanumeric display with backlight, an alarm LED, and a keypad consisting of pushbutton switches.

B. Metered Data: The following metered data, shall be available on the alphanumeric display:

1. Year, Month, Day, Hour, Minute, Second of occurring events
2. Source Input Voltage
3. Output AC voltage
4. Output AC current
5. Input Frequency
6. Battery voltage
7. Highest Internal Battery temperature

C. Event log: The display unit shall allow the user to display a time and date stamped log of the 64 most recent status and alarm events.

D. Alarms: The display unit shall allow the user to display a log of all active alarms. The following minimum set of alarm conditions shall be available:

1. Static bypass switch on
2. EPO Active
3. Mechanical bypass activated
4. External bypass switch (Q3) activated
5. Battery discharged
6. Return from low battery
7. Low battery
8. Load not powered from UPS
9. UPS in bypass
10. Runtime calibration aborted
11. Runtime calibration started
12. Runtime calibration complete

13. Battery self test aborted
14. Battery self test started
15. Battery self test completed
16. Number of battery modules decreased
17. Number of battery modules increased
18. Fan fault
19. SBS fault
20. System not in sync.
21. Bypass not available, frequency/voltage out of range
22. Mains voltage/frequency out of range
23. Site wiring fault
24. Low battery voltage shut down
25. XR battery breaker or fuse open
26. Defective battery detected
27. Runtime is below alarm threshold
28. Load is above alarm threshold
29. Battery over-voltage warning
30. Battery over-temperature warning
31. Emergency power supply fault
32. Output overloaded

J. Controls: The following controls or programming functions shall be accomplished by use of the display unit. Pushbutton membrane switches shall facilitate these operations.

1. Silence audible Alarm
2. Set the alphanumeric display language
3. Display or set the date and time

4. Enable or disable the automatic restart feature

5. Transfer critical load to and from static bypass

6. Test battery condition on demand

7. Set intervals for automatic battery tests

8. Adjust set points for different alarms

9. Program the parameters for remote shutdown.

G. Front Panel Interface: The following shall make up the UPS front panel user interface.

1. Indicating LED's

a.	Load On	When Green, this LED indicates the load is being supported by the UPS output
b.	On Battery	When Yellow, this LED indicates the UPS is running from Battery power
c.	Bypass	When Yellow, this LED indicates the load is being supported by static bypass/mechanical bypass
d.	Fault	When Red, this LED indicates there is a fault condition present in the UPS.

2. Push Button User Controls

a. Up Arrow
b. Down Arrow
c. Help Key
d. Escape Key
e. Enter Key

H. Potential Free (Dry) Contacts

1. The following potential free contacts shall be available on an optional relay interface board (AP9610 or equivalent). (Note: This may require the use of an external chassis if used in conjunction with web based management or other "smart slot" type devices):

a. Normal Operation
b. Battery Operation
c. Bypass Operation
d. Common Fault
e. Low Battery
f. UPS Off

I. Communication Interface: For purposes of remote communications with the UPS the following shall be available and contained within the UPS on a removable, "hot swappable" "smart slot" interface card:

1. RJ-45 Interface port for remote communications with a network via web browser or SNMP, or APC InfraStruXure Manager.

2. Environmental monitoring feature, capable of locally monitoring temperature and humidity as well as one additional generic set of user determined dry contacts capable of taking an input signal from any APC or third party on/off signal, such as water detection, smoke detection, motion, or fire detection.

2.8 BATTERY

A. The UPS battery shall be of modular construction made up of user replaceable, hot swappable, fused, battery modules. Each battery module shall be monitored for voltage and temperature for use by the UPS battery diagnostic, and temperature compensated charger circuitry.

B. The battery jars housed within each removable battery module shall be of the Valve Regulated Lead Acid (VRLA) type.

PART 3 – ACCESSORIES

3.1 EXTENDED RUNTIME (XR) OPTION

A. For purposes of extending the UPS battery runtime, external extended runtime options shall be available. The extended runtime option shall be housed in enclosures and shall contain necessary hardware and cables to connect to the UPS, or between XR enclosures. Each XR enclosure shall be equipped with removable, hot swappable, battery units housed in draw-out cartridges.

B. The extended runtime system shall have a 250 VDC rated, thermal magnetic trip molded case circuit breaker. Each circuit breaker shall be equipped with shunt trip mechanisms and 1A/1B auxiliary contacts. The circuit breakers are to be equipped as part of a line-up-and-match type battery enclosure.

3.2 RACK MOUNT POWER DISTRIBUTION UNITS

A. For purposes of distributing power within an IT enclosure, rack mount power distribution units shall be available. The rack mount power distribution units shall be capable of being installed in the back of the accompanying enclosure.

B. Output Connections - The output of the Rack Mount PDU shall be fed from 208Y120Volts, and shall be distributed to receptacles capable of supplying power to cord connected equipment.

3.2 RACK MOUNT TRANSFER SWITCHES

For purposes of providing redundancy (to single corded loads) as far as the equipment rack, and the load itself, 1U rack mount transfer switches shall be available. Rack mount transfer switches shall be capable of switching a combination of single-phase and three-phase loads up to 5.7kW. The Rack Mount Transfer Switch shall be designed to be fed from a 3 pole 20A circuit breaker via a NEMA L21-20 receptacle or cord cap.

3.3 OVERHEAD DISTRIBUTION

A. Flexible Distribution Conductors - For purposes of overhead distribution wiring of datacenter branch circuits from the output distribution panel, flexible conductors of either an SJO type, or TC type shall be available as a distribution means. Flexible conductors shall be equipped with NEMA or IEC style cord caps and shall be agency approved under UL60950 as part of the InfraStruxure™ system.

B. Cable Ladder - For purposes of routing data and power cables between rows in a datacenter aisle layout, cable ladders shall be available to span the gap between rows. Cable ladders shall be agency approved under UL60950 as part of the InfraStruXure™ system. The use of over head cable management shall minimize the need to run data and power cable beneath a raised floor, thus minimizing potential air flow obstructions for down-flow type precision cooling solutions. This means of cable management shall also facilitate ease of installation of power and data cabling in datacenters not utilizing raised floor. Optional covers shall be available for ladders as a means of adhering to local codes requiring such.

C. Cable Trough - For purposes of routing data and power cable along the length of a row of IT enclosures in a data center environment, cable troughs shall be available as a means of separating and housing data and power cable. Optional covers shall be available for troughs as a means of adhering to local codes requiring such. The use of over head cable management shall minimize the need to run data and power cable beneath a raised floor, thus minimizing potential air flow obstructions for down-flow type precision cooling solutions. This means of cable management shall also facilitate ease of installation of power and data cabling in datacenters not utilizing raised floor.

3.4 INFORMATION TECHNOLOGY (IT) ENCLOSURE

IT enclosures shall be available for housing of customer supplied IT equipment. Enclosures shall be listed under the same UL60950 agency approval as other products outlined within this specification.

A. General Requirements

1. The Enclosure shall be designed to provide a secure, managed environment for computer and networking equipment.

2. The Enclosure shall conform to EIA-310 Standard for Cabinets, Racks, Panel and Associated Equipment and accommodate industry standard 19” rack mount equipment.

3. The Enclosure shall be designed with four (4) vertical posts to allow rack mount equipment installation utilizing four (4) vertical mounting rails.

4. The Enclosure shall be available with a vertical equipment mounting space of 25U, 42U or 47U. (1U=1.75” or 44.45mm)

5. A four-post open frame configuration shall be available with 42U vertical equipment mounting space.

B. Physical Requirements

1. External Width Dimensions shall be 597mm (23.5”) for 19” rack enclosures, and 747mm (29.4”) for 23” rack enclosure.

2. External Depth Dimensions shall be 900mm (35.4”) or 1070mm (42.2”)

3. Rack enclosures of a 42U design shall have a maximum external height of 2070mm (81.5”) to allow passage through a standard 7ft. (84”) doorway without tipping.

4. Rack enclosure shall support a dynamic load (rolling on castors) of 909kG (2000 lbs.) total weight.

5. Rack enclosure shall also be designed and manufactured to be matching in both color and construction to the UPS, PDU/System bypass and extended runtime battery enclosures to provide a uniform and consistent appearance in a datacenter environment.

C. Equipment Access and Mounting

1. The enclosure shall provide [25U] [42U] [47U] of equipment vertical mounting space.

2. The vertical mounting rails shall be adjustable to allow different mounting depths.

3. Front and rear doors of the enclosure shall be designed with quick release hinges allowing for easy detachment without the use of tools.

3.5 FLOOR ANCHOR BRACKETS

Floor Anchor brackets shall be available to solidly connect UPS and Battery Enclosure to minimize unintended moving of the equipment.

3.6 SEISMIC FLOOR STANDS

Seismic rated floor stands shall be available to take the place of supporting the system on a raised floor environment. Floor Stands shall be available in custom heights to maintain a flush mount installation adjacent to the raised floor, and shall be designed in accordance to the equipment weight and contact points.

3.7 SOFTWARE AND CONNECTIVITY

A. Network Adaptor: The Ethernet Web/SNMP Adaptor shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments. The management information base (MIB) shall be provided in DOS and UNIX "tar" formats. The SNMP interface adaptor shall be connected to the UPS via the RS232 serial port on the standard communication interface board.

B. Unattended Shutdown

1. The System, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems during when the UPS is on reserve mode.

2. The System shall also be capable of using an RS232 port to communicate by means of serial communications to gracefully shut down one or more operating systems during an on battery situation.

3.8 REMOTE SYSETEM MONITORING

A. The following three methods of remote UPS monitoring shall be available:

1. Web Monitoring: Remote monitoring shall be available via a web browser such as Internet Explorer.

2. RS232 Monitoring: Remote UPS monitoring shall be possible via either RS232 or contact closure signals from the UPS.

3. Simple Network Management Protocol (SNMP): Remote UPS Monitoring shall be possible through a standard MIB II compliant platform.

3.9 SOFTWARE COMPATIBILITY

A: The UPS manufacturer shall have available software to support graceful shutdown and remote monitoring for the following systems:

a. Microsoft Windows 95/98/XP
b. Microsoft Windows NT 4.0 SP6/2000
c. OS/2
d. Netware 3.2 – 5.1
e. MAC OS 9.04, 9.22, 10
g. Digital Unix/True 64
h. SGI 6.0-6.5
j. SCO UNIX
k. SVR4 2.3, 2.41
m. SCO Unix Ware 7.0 - 7.11
n. SUN Solaris 2.6-2.8
o. SUN OS 4.13, 4.14
p. IBM AIX 4.3x-4.33g, 5.1

q. HP-UX 9.x-11.i
r. Linux

3.10 INFRASTRUXURE™ MANAGER

For purposes of complete system monitoring and management of all components outlined in this specification, there shall be a centralized manager, hereafter referred to as ISX Manager.

A. Monitoring - ISX Manager shall be capable of monitoring all products in this specification including, UPS, PDU/System Bypass, Extended Run Battery Enclosures, and rack level distribution options through a network of category 5 cable and a 24 port hub, supplied by the UPS manufacturer. This 24 port hub shall relay information to the ISX Manager, which in turn shall allow access to this information via the user's public network via a single IP address.

B. Monitored Values - ISX Manager shall be capable of monitoring alarms, general status parameters, voltage and current of products outlined in section 3.15.A. of this specification.

C. Thresholds - For individualized customer needs, ISX Manager shall allow for user configurable thresholds for alarm notification. With this feature ISX Manager can notify clients of reaching thresholds for UPS capacity, PDU capacity, or branch circuit breaker capacity. Other custom programmable alarm points for non- APC products shall also be available via dry contact input signal.

D. Public Network Monitoring - The ISX Manager shall also be capable of monitoring other APC devices that are connected to the client's public network.

Part 4 - EXECUTION

4.1. FACTORY ASSISTED START-UP

If a factory assisted UPS start-up is requested, factory trained service personnel shall perform the following inspections, test procedures, and on-site training:

A. Visual Inspection:

1. Inspect equipment for signs of damage.
2. Verify installation per manufacturer s instructions.
3. Inspect cabinets for foreign objects.
4. Inspect Battery Units.
5. Inspect Power Modules.

B. Mechanical Inspection:

1. Check all UPS and external maintenance bypass cabinet internal control wiring connections.

2. Check all UPS and external maintenance bypass cabinet internal power wiring connections.

3. Check all UPS and external maintenance bypass cabinet terminal screws, nuts, and/or spade lugs for tightness.

C. Electrical Inspection:

1. Verify correct input and bypass voltage.

2. Verify correct phase rotation of all mains connections.

3. Verify correct UPS control wiring and terminations.

4. Verify voltage of all battery modules.

5. Verify neutral and ground conductors are properly landed.

6. Inspect external maintenance bypass switch for proper terminations and phasing.

D. Site Testing:

1. Ensure proper system start-up.

2. Verify proper firmware control functions.

3. Verify proper firmware bypass operation.

4. Verify proper maintenance bypass switch operation.

5. Verify system set points.

6. Verify proper inverter operation and regulation circuits.

7. Simulate utility power failure.

8. Verify proper charger operation.

9. Document, sign, and date all test results.

E. On-Site Operational Training: During the factory assisted start-up, operational training for site personnel shall include key pad operation, LED indicators, start-up and

shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

4.2 MANUFACTURER FIELD SERVICE

A. Worldwide service: The UPS manufacturer shall have a worldwide service organization Available, consisting of factory trained field service personnel to perform start-up, preventative maintenance, and service of the UPS system and power equipment. The service organization shall offer 24 hours a day, 7 days a week, 365 days a year service support.

B. Replacement parts: Parts shall be available through the worldwide service organization 24 hours a day, 7 days a week, and 365 days a year. The worldwide service organization shall be capable of shipping parts within 4 working hours or on the next available flight, so that the parts may be delivered to the customer site within 24 hours.

4.3 MAINTENANCE CONTRACTS

A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available. All contract work shall be performed by APC factory trained service personnel.

4.4 TRAINING

UPS service training workshop: A UPS service training workshop shall be available from the UPS manufacturer. The service training workshop shall include a combination of lecture and practical instruction with hands-on laboratory sessions. The service training workshop shall include instruction about safety procedures, UPS operational theory, sub-assembly identification and operation, system controls and adjustment, preventative maintenance, and troubleshooting.