APC Symmetra LX

GUIDE SPECIFICATIONS FOR
4kVA-16kVA
Uninterruptible Power System

PART 1 - GENERAL

1.1 SUMMARY

A. This specification describes the operation and functionality of a continuous duty, single-phase, solid-state, static Uninterruptible Power System (UPS) hereafter referred to as the UPS.

B. The UPS shall utilize modular power protection technology designed to allow internal redundancy, scalability of power and runtime, and fast mean time to repair (MTTR). The UPS should be configured from five basic components- UPS frames, extended run battery frames (XR frames), power modules, battery modules, and intelligence modules. UPS and XR frames should be capable of shipping with modules installed. XR frames should be capable of communicating battery and runtime status to intelligence modules. Power, battery, and intelligence modules should be hot-swappable and user-replaceable for fast MTTR.

C. Configuration Specifics:

1. The UPS frame(s) should be capable of the following configurations:

____4-8kVA N+1 Redundant Tower
____4-16kVA N+1 Redundant Tower
____4-16kVA N+1 Redundant Tower with nine (9) extra Battery Module slots
____4-8kVA N+1 Redundant 13U Rack-mount
____4-16kVA N+1 Redundant 19U Rack-mount

2. The system power train shall be comprised of hot-swappable, user-replaceable 3.2kW/4kVA and 10% Battery charger circuit power modules, which shall operate in parallel, and be configurable for N+1 redundant operation at rated load.

3. The system shall also include a field-replaceable internal automatic and manual bypass system module, field-replaceable output power distribution panels, removable input/output wiring tray, standard redundant intelligent modules, battery disconnects, an LCD interface display, EPO, and an integrated UPS network management card with temperature monitoring.

D. In addition, this specification describes the performance, functionality, and design of the UPS Service Bypass Panel, hereafter referred to as the SBP, the external Battery Systems, and connectivity solutions.

E. The UPS and associated equipment shall operate in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for mission critical, electronic equipment load.

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

1.2 STANDARDS

A. UL 1778 Uninterruptible Power Supply Equipment

B. CSA

C. FCC Class A

D. ISO 9001

E. ISO 14001

1.3 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. Recharge: Upon restoration of the AC input source, the input converter and output inverter shall simultaneously recharge the battery and provide regulated power to the critical load.

D. Automatic Bypass: The automatic 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.

E. Manuel Bypass: The system shall be equipped with an internal make-before-break two pole switch to electrically isolate the UPS from the input and output during preventative maintenance, module upgrades, or limited frame service. The manual bypass shall also be considered a partial ‘wrap-around’ bypass, and shall be configured to wrap around the power modules (recitifier, battery charger, inverter) , and battery modules in the same manner as the automatic bypass will still supplying surge and EMI filtering, and overcurrent protection. There will be a positional sense supplied to alert users that the UPS is in manual bypass.

F. External Service Bypass Panel (SBP): The maintenance service bypass cabinet shall provide power to the critical load bus from the bypass source, during times where maintenance or service of the UPS frame is required or when removal of the frame is desired. The SBP shall provide a mechanical means of complete isolation of the UPS from the electrical wiring of the installation. The SBP shall be constructed in a free-standing, rack mounted or wall-mounted NEMA 1 enclosure unless otherwise stated in this specification. It shall be designed for either three phase input or single phase input with a " no break" transfer between bypass and UPS power.

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.

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.

PART 2 – PRODUCT

2.1 DESIGN REQUIREMENTS

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

B. The UPS shall be scalable to final capacity of _____ kVA and _____ kW load.

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

2.2 SYSTEM CHARACTERISTICS

A. System Capacity: The system shall be rated for .8 Pf output in the following frame sizes:

1. 8 kVA/ 6.4kW - Can be configured with up to (3), 3.2kW power modules for N+1

2. 16 kVA/ 12.8kW - Can be configured with up to (5), 3.2kW power modules for N+1

B. Input:

1. AC Input Nominal Voltage: 208 V or 240V, Single Phase, 4 wire (2 Phase+ N + G), 60 Hz.

2. AC Input Voltage Window: 155 -276 for 240V or 166-240V for 208V (while providing nominal charging to the battery system).

3. Maximum Frequency Range: 45-65Hz

4. Input Power Factor:
a. Minimum .90 lagging at 100% load at 208 V
b. Minimum .98 lagging at 100% at 240 V

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

a. < 5% at 100% load at 240V

D. UPS Output:

1. AC Output Nominal Output: 120/208V or 120/240V , Single Phase, 4 wire (2Phase + N + G), 50 or 60 Hz.

2. AC Output Voltage Distortion: Max. 5% @ 100% Linear Load, phase to neutral loads.

3. AC Output Voltage Regulation: $^{+}$/- 3% For 100 % Linear or Nonlinear Load, phase to neutral loads.

4. Voltage Transient Response: $^{+}$/_ 5% maximum for 100% load step

5. Voltage Transient Recovery within <60 milliseconds

6. Output Voltage Harmonic Distortion:

a. <2% THD maximum and 1% single harmonic for a 100% linear load
b. <5% THD maximum for a 100% non-linear load

7. Overload Rating:

a. Normal Operation:

1) >130% for 4 seconds
2) 105% continuous
3) <130% Continuous at N+1

b. Bypass Operation:

1) 100A continuous

8. System AC-AC Efficiency: >90% at 100% load

10. Output Power Factor Rating: The UPS output shall be .8 lagging

2.3 ENVIRONMENTAL

A. Storage Ambient Temperature: 5°F to 113°F (-15°C to 45°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

E. Altitude: Maximum installation with no derating of the UPS output shall be 10,000 feet (3000m) above sea level.

2.4 INPUT POWER CONVERTER

A. The input power converters of the system are housed within the parallel connected, removable power modules, and 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 6% 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.

E. Input Current Limit:

1. The input converter shall control and limit the input current draw from utility to 150% of the UPS output. During conditions where input current limit is active, the UPS shall be able to support 100% load, charge batteries at 10% of the UPS output rating, and provide voltage regulation with mains deviation of up to +/- 20% of the nominal input voltage.

2. In cases where the source voltage to the UPS is nominal and the applied UPS load is equal to or less than 100% of UPS capacity, input current shall not exceed 130% of UPS output current, while providing full battery recharge power and importing necessary power for system losses.

F. Redundancy: The UPS shall be configured with redundant input converters, each with semiconductor fusing, and logic controlled contactors to remove a failed module from the input bus.

G. Charging:

1. The battery charging shall keep the DC bus float voltage of +/137v, +/-1%

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

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

H. Back-feed Protection: The above-mentioned logic controlled contactor also provides the back-feed protection required by UL1778.

2.6 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 bi-directional 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: The output power converters shall be capable of 200% for short-circuit clearing. Steady-state overload conditions, of up to 130% of system capacity (N+1), shall be sustained by the inverter continuously in normal and battery operation. Should overloads persist past the outlined limitation, the critical load will be switched to the automatic bypass output of the UPS which is based upon the rating of 100A.

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

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

J. Redundancy: The UPS shall be configured with redundant output inverters, each with semiconductor fusing, and logic controlled relays to remove a failed component from the critical bus.

2.7 AUTOMATIC BYPASS

A. As part of the UPS, a system automatic bypass switch shall be provided. The system automatic bypass shall provide a break <11Ms transfer of the critical load from the Inverter output to the automatic 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. The additional manual bypass switch will have a no break transfer of critical loads from Inverter output to the manual bypass switch which will correspondingly engage the automatic bypass switch driving it into bypass position. The UPS shall constantly monitor the output current, as well as the bypass source voltage, and inhibit potentially unsuccessful transfers to automatic bypass from taking place.

B. The design of the automatic bypass switch power path shall consist of a heavy duty electromechanical bypass contactor with a continuous duty rating up to 100A.

C. Automatic Transfers: An automatic transfer of load to 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 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 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 s bypass shall be initiated through the UPS display interface or by engaging the manual bypass switch on the front of the unit.

E. Overloads: The automatic bypass shall be rated and capable of handling overloads equal to or less than 100A continuously. For instantaneous overloads caused by inrush current from magnetic devices, or short circuit conditions, the automatic bypass shall be capable of sustaining overloads of 1000% of system capacity for sub cycle fault clearing.

F. Modular: The automatic bypass switch shall be of a modular design and easily field replaceable by certified technicians

2.8 DISPLAY AND CONTROLS

A. Control Logic: The UPS shall be controlled by two fully redundant, user-replaceable / hot-swappable intelligence modules. These modules shall have separate, optically isolated, communication paths to the power modules and the automatic bypass contactor. Logic power for the control modules shall be derived from internal regulated power supplies, each having a separate AC and DC input and output. The communication of the control modules shall be of Inter IC Communication(IIC).

B. Display Unit: A microprocessor controlled display unit shall be located on a hinged door in 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. Internal 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. Input Frequency outside configured range
2. AC adequate for UPS but not for Bypass
3. Low/No AC input, startup on battery
4. Intelligence Module inserted
5. Intelligence Module removed
6. Redundant Intelligence Module inserted
7. Redundant Intelligence Module removed
8. Number of Batteries changed since last ON
9. Number of Power Modules changed since last ON
10. Number of Batteries increased
11. Number of Batteries decreased
12. Number of Power Modules increased
13. Number of Power Modules decreased
14. Redundancy Restored

15. Need Battery Replacement
16. The Redundant Intelligence Module is in control
17. UPS Fault
18. On Battery
19. Shutdown or unable to transfer to battery due to overload
20. Load Shutdown from Bypass. Input Frequency Volts outside limits
21. Fault, Internal Temp exceeded system normal limits
22. Input Circuit Breaker Open
23. System level fan failed
24. Bad Battery Module
25. Bad Power Module
26. Intelligence Module is installed and failed
27. Redundant Intelligence Module is installed and failed
28. Redundancy has been lost
29. Redundancy is below alarm threshold
30. Runtime is below alarm threshold
31. Load is above alarm threshold
32. Load is no longer above alarm Threshold
33. Minimum Runtime restored
34. Bypass is not in range (either frequency or voltage)
35. Bypass contactor stuck in OFF position
36. Bypass contactor stuck in ON position
37. UPS in Bypass due to Internal Fault
38. UPS in Bypass due to overload
39. Low Battery Shutdown
40. Low Battery Warning

K. 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. Display or set the date and time

3. Enable or disable the automatic restart feature

4. Transfer critical load to and from bypass

5. Test battery condition on demand

6. Set intervals for automatic battery tests

7. Adjust set points for different alarms

8. Program the parameters for remote shutdown.

G. Potential Free (Dry) Contacts

1. The following potential free contacts shall be available on an optional relay interface board:

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

H. Communication Interface Board: A communication interface board shall provide the following communication ports which can be used simultaneously:

1. RS232 Serial Port #1

2. RJ-45 Interface port for a Remote Display

3. Extended runtime external battery communication port

2.9 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 battery charger circuitry.

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

C. The UPS shall incorporate a battery management system to continuously monitor the health of each removable battery module as well as external battery modules installed in extended run battery cabinets. This system shall notify the user in the event that a failed or weak battery module is found.

D. Additional battery modules may be added to increase runtime by utilizing up to seven extended run battery cabinets. These cabinets will be hot pluggable allowing for easy and quick installation with the need for electrical wiring, electrcian or powering down of the UPS. The battery modules shall be monitored by each individual frame and this information passed upstream to the main intelligence modules.

E. Battery modules will have an embedded EEprom that will supply the serial number as well as some diagnostic information to user to help in the local, network or out of band management of these modules.

F. Each UPS Battery Module shall have a built in DC disconnect switch for transportation and to disconnect the battery module completely from the internal bus while installed in the UPS system.

PART 3 – ACCESSORIES

3.1 SERVICE BYPASS PANEL (SBP)

A. The service bypass panel shall provide power to the critical load bus from the bypass source, during times where maintenance or service of the UPS frame is required. The SBP shall provide a mechanical means of complete isolation of the UPS from the electrical wiring of the installation. The SBP shall be constructed in a free-standing, rack mounted or wall-mounted NEMA 1 enclosure unless otherwise stated in this specification.

3.2 REMOVABLE INPUT/OUPUT ELECTRICAL TERMINAL

A. The input and output terminal connections shall be designed to be a removable tray for easy electrical connection.

3.4 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 UPS, 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 UPS 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.

3.5 REMOTE UPS 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.

3.6 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

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 service bypass panel internal power wiring connections.
2. Check all UPS and external service bypass panel terminal screws, nuts, and/or spade lugs for tightness.

C. Electrical Inspection:

1. Verify correct input and bypass voltage.
2. Verify correct UPS control wiring and terminations.
3. Verify voltage of all battery modules.
4. Verify neutral and ground conductors are properly landed.
5. Inspect external service bypass panel for proper terminations.

D. Site Testing:

1. Ensure proper system start-up.
2. Verify proper firmware control functions.
3. Verify proper firmware bypass operation.
4. Verify proper 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, 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.

End Of Section 16611