

APC by Schneider Electric

MGE GALAXY 3500

Uninterruptible Power Supply

Guide Specifications

10-30 kVA

Three-Phase, 208 Volts, 60 Hertz Solution

THIS GUIDE SPECIFICATION IS WRITTEN IN ACCORDANCE WITH THE CONSTRUCTION SPECIFICATIONS INSTITUTE (CSI) MASTERFORMAT. THIS SECTION MUST BE CAREFULLY REVIEWED AND EDITED BY THE ARCHITECT OR THE ENGINEER TO MEET THE REQUIREMENTS OF THE PROJECT. COORDINATE THIS SECTION WITH OTHER SPECIFICATION SECTIONS IN THE PROJECT MANUAL AND WITH THE DRAWINGS.

WHERE REFERENCE IS MADE THROUGHOUT THIS SECTION TO "PROVIDE", "INSTALL", "SUBMIT", ETC., IT SHALL MEAN THAT THE CONTRACTOR, SUBCONTRACTOR, OR CONTRACTOR OF LOWER TIER SHALL "PROVIDE", "INSTALL", "SUBMIT", ETC., UNLESS OTHERWISE INDICATED.

THIS SECTION IS WRITTEN TO INCLUDE THE 2004 MASTERFORMAT AND THE 1995 MASTERFORMAT VERSIONS. WHERE APPLICABLE, THESE ITEMS ARE BRACKETED AND, IN EACH CASE, UNLESS OTHERWISE INDICATED, THE FIRST CHOICE APPLIES TO THE 2004 MASTERFORMAT AND THE SECOND CHOICE APPLIES TO THE 1995 MASTERFORMAT.

SECTION [26 33 63.17] [16611-11]

SOLID STATE UNINTERRUPTIBLE POWER SUPPLY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions, [Division 01 - GENERAL REQUIREMENTS] [Division 1 - GENERAL REQUIREMENTS], and other applicable specification sections in the Project Manual apply to the work specified in this Section.

1.2 SUMMARY

- A. **Scope:** Provide design and engineering, labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, erection, and installation for a solid state uninterruptible power supply (UPS) as required for the complete performance of the work, and as shown on the Drawings and as herein specified.
- B. **Section Includes:** The work specified in this Section includes, but shall not be limited to, a three-phase, continuous duty, solid state UPS. The UPS shall contain a full rated input rectifier/boost converter (hereafter referred to as input converter), output inverter, and 10 percent battery charging circuit. The system shall also contain a continuous duty bypass static switch, internal mechanical bypass, removable hot swap battery plant, and LCD interface display. All of the above system components shall be housed in a single enclosure.
 - 1. In addition, this Section describes the performance, functionality, and design of the UPS maintenance bypass cabinet (MBC), the extended run (XR) battery system, connectivity solutions, and paralleling operation.
 - 2. 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.
 - 3. All programming and miscellaneous components for a fully operational system as described in this Section shall be available as part of the UPS.

1.3 REFERENCES

- A. **General:** The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the

referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

- B. **Institute of Electrical and Electronics Engineers, Inc. (IEEE):**
 - 1. ANSI/IEEE 519, "Guide for Harmonic Control and Reactive Compensation of Static Power Converters" (copyrighted by IEEE, ANSI approved).
- C. **International Organization for Standardization (ISO):**
 - 1. ISO 9001, "Quality Management Systems - Requirements."
 - 2. ISO 14001, "Environmental Management Systems - Requirements With Guidance for Use."
- D. **Underwriters Laboratories, Inc. (UL):**
 - 1. UL 1778, "Standard for Uninterruptible Power Supply Equipment" (copyrighted by UL, ANSI approved).

1.4 SYSTEM DESCRIPTION

- A. **Design Requirements:**
 - 1. The UPS shall be sized for [] kVA and [] kW load.

INSERT APPLICABLE VALUES IN SUBPARAGRAPHS ABOVE AND BELOW.

- 2. The UPS battery shall be sized for [] kW at a power factor of [] for [] minutes.

- B. **System Characteristics:**
 - 1. **System Capacity:** The system shall be rated in the following sizes:
 - a. 10 kVA/8 kW.
 - b. 15 kVA/12 kW.
 - c. 20 kVA/16 kW.
 - d. 30 kVA/24 kW.
 - 2. **Input:**
 - a. **AC Input Nominal Voltage:** 208 volts, three-phase, 4 wires plus ground, 60 hertz.
 - b. **AC Input Voltage Window:** +15 percent, -20 percent of nominal (while providing nominal charging to the battery system).
 - c. **Short Circuit Withstand Rating:** 30,000 symmetrical amperes.
 - d. **Maximum Frequency Range:** 40 to 70 hertz.
 - e. **Input Power Factor:**
 - 1) 0.98 for loads greater than 50 percent.
 - 2) 0.95 for loads greater than 15 percent.
 - f. **Input Current Distortion With No Additional Filters:** Less than 5 percent at 100 percent load.
 - g. **Soft-Start:** Shall be linear from 0 percent to 100 percent 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.
 - 3. **UPS Output:**
 - a. **AC Output Nominal Output:** 208/120 volts, three-phase, 4 wires plus ground, 60 hertz.
 - b. **AC Output Voltage Regulation:** ± 1 percent for 100 percent linear or non-linear load.
 - c. **Voltage Transient Response:** ± 5 percent maximum for 100 percent linear load step.
 - d. **Voltage Transient Recovery:** Within less than 60 milliseconds.
 - e. **Output Voltage Harmonic Distortion:**
 - 1) Less than 2 percent THD maximum and 1 percent single harmonic for a 100 percent linear load.
 - 2) Less than 5 percent THD maximum for a 100 percent non-linear load.
 - f. **Phase Angle Displacement:**
 - 1) 120 degrees ± 0.1 degree for balanced load.
 - 2) 120 degrees ± 0.1 degree for 50 percent imbalanced load.
 - 3) 120 degrees ± 0.3 degrees for 100 percent imbalanced load.

- g. **Overload Rating:**
 - 1) **Normal Operation:**
 - a) 150 percent for 1 minute.
 - b) 125 percent for 10 minutes.
 - c) 100 percent continuous.
 - 2) **Bypass Operation:**
 - a) 100 percent continuous.
 - b) 800 percent for 500 milliseconds.
- h. **System AC-AC Efficiency:** Greater than 93 percent at full load with 208 volt supply.
- i. **Output Power Factor Rating:** 0.8 at full load.
- j. **Slew Rate:** 0.25 to 1 hertz/second.

1.5 SUBMITTALS

- A. **General:** See [Section 01 33 00 - SUBMITTAL PROCEDURES] [Section 01300 - SUBMITTALS].
- B. **Product Data:** Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Product data shall include, but shall not be limited to, the following:
 - 1. As bid system bill of materials.
 - 2. Product catalog sheets or equipment brochures.
 - 3. Product guide specifications.
- C. **Shop Drawings:** Submit shop drawings for each product and accessory required. Include information not fully detailed in manufacturer's standard product data, including, but not limited to, the following:
 - 1. Installation information, including, but not limited to, weights and dimensions.
 - 2. Information about terminal locations for power and control connections.
 - 3. Drawings for requested optional accessories.
- D. **Wiring Diagrams:** Submit wiring diagrams detailing power, signal, and control systems, clearly differentiating between manufacturer-installed wiring and field-installed wiring, and between components provided by the manufacturer and those provided by others.
 - 1. Submit system single-line operation diagram.
- E. **Operation and Maintenance Data:** Submit operation and maintenance data to include in operation and maintenance manuals specified in [Division 01 - GENERAL REQUIREMENTS] [Division 1 - GENERAL REQUIREMENTS], including, but not limited to, safe and correct operation of UPS functions.
 - 1. Submit an installation manual, which shall include, but shall not be limited to, instructions for storage, handling, examination, preparation, installation, and start-up of UPS.
 - 2. Submit an operation and maintenance manual, which shall include, but shall not be limited to, operating instructions.

1.6 QUALITY ASSURANCE

- A. **Qualifications:**
 - 1. **Manufacturer Qualifications:** Manufacturer shall be a firm engaged in the manufacture of solid state UPS of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of 20 years.
 - a. The manufacturer shall be ISO 9001 certified and shall be designed to internationally accepted standards.
 - 2. **Installer Qualifications:** Installer shall be a firm that shall have a minimum of five years of successful installation experience with projects utilizing solid state UPS similar in type and scope to that required for this Project.

- B. **Regulatory Requirements:** Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and local authorities having jurisdiction. Obtain necessary approvals from such authorities.
1. Where applicable, the UPS shall also be designed in accordance with publications from the following organizations and committees:
 - a. National Fire Protection Association (NFPA).
 - b. National Electrical Manufacturers Association (NEMA).
 - c. Occupational Safety and Health Administration (OSHA).
 - d. Institute of Electrical and Electronics Engineers, Inc. (IEEE); ANSI/IEEE 519.
 - e. ISO 9001
 - f. ISO 14001
- C. **Pre-Installation Conference:** Conduct pre-installation conference in accordance with [Section 01 31 19 - PROJECT MEETINGS] [Section 01200 - PROJECT MEETINGS]. Prior to commencing the installation, meet at the Project site to review the material selections, installation procedures, and coordination with other trades. Pre-installation conference shall include, but shall not be limited to, the Contractor, the Installer, and any trade that requires coordination with the work. Date and time of the pre-installation conference shall be acceptable to the Owner and the Architect/Engineer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and lot number, if any.
- B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1.8 PROJECT CONDITIONS

- A. **Environmental Requirements:** Do not install solid state UPS until space is enclosed and weatherproof, wet work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.
1. The UPS shall be capable of withstanding any combination of the following environmental conditions in which it must operate without mechanical or electrical damage, or degradation of operating characteristics.
 - a. **Storage Ambient Temperature:** -22 °F (-30 °C) to 158 °F (70 °C) without internal battery; 5 °F (-15 °C) to 113 °F (45 °C) with internal batteries.
 - b. **Operating Ambient Temperature:** 32 °F (0 °C) to 104 °F (40 °C) (77 °F [25 °C] is ideal for most battery types).
 - c. **Relative Humidity:** 0 percent to 95 percent non-condensing.
 - d. **Altitude:** Maximum installation with no derating of the UPS output shall be 3281 feet (1000 meters) above sea level.
 - e. **Audible Noise:** The UPS shall not produce audible noise at a distance of 39 inches (1 meter) in excess of the following:
 - 1) **10 kVA to 15 kVA:** 51 dBA.
 - 2) **20 kVA to 30 kVA:** 55 dBA.

1.9 WARRANTY

- A. **General:** See [Section 01 77 00 - CLOSEOUT PROCEDURES] [Section 01770 - CLOSEOUT PROCEDURES].
- B. **Special Warranty:** The Contractor shall warrant the work of this Section to be in accordance with the Contract Documents and free from faults and defects in materials and workmanship for period

indicated below. This special warranty shall extend the one year period of limitations contained in the General Conditions. The special warranty shall be countersigned by the Installer and the manufacturer.

1. **UPS Module:** The UPS shall be covered by a full parts and labor warranty from the manufacturer for a period of 12 months from date of installation or acceptance by the Owner or 18 months from date of shipment from the manufacturer, whichever occurs first.
2. **Battery:** The battery manufacturer's warranty shall be passed through to the final Owner and shall have a minimum period of one year.

- C. **Additional Owner Rights:** The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

1.10 MAINTENANCE

- A. A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available from the manufacturer. Contract work shall be performed by factory-trained service personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Basis of Design:** Product specified is "MGE Galaxy 3500" as manufactured by APC by Schneider Electric. Items specified are to establish a standard of quality for design, function, materials, and appearance. Equivalent products by other manufacturers are acceptable. The Architect/Engineer will be the sole judge of the basis of what is equivalent.

2.2 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 UPS shall simultaneously recharge the battery and provide regulated power to the critical load.
- D. **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 shall be able to recharge the batteries while supplying full power to the load via the static bypass switch.
- E. **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.
- F. **External Maintenance (Wrap-Around) Bypass:** As an option for a single UPS unit, the system may be equipped with an external MBC to electrically isolate the UPS during routine maintenance

and service of the UPS. The MBC shall completely isolate both the UPS input and output connections. The MBC shall be used for paralleling of multiple UPS units.

2.3 INPUT POWER CONVERTER

- A. **General:** 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 shall be held to 5 percent or less at full system load, 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 percent to 100 percent 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 ($di/dt = \text{constant}$).
- 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 six times the nominal input current of the transformer.
- E. **Input Current Limit:** The system input current limit, shall be designed to provide 100 percent load while fully charging the batteries at 10 percent of the system rating. The system shall be capable of this with up to a +15 percent, -20 percent variation of the nominal input voltage.
- F. **Charging:**
 - 1. The battery charging shall keep the DC bus float voltage of ± 220 volts, ± 1 percent.
 - 2. The battery charging circuit shall contain a temperature compensation circuit, which shall 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. 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 shall be set to 100 percent 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 Owner-selectable increments of 75 percent, 50 percent, 25 percent, 10 percent and 0 percent 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 UL 1778.

2.4 OUTPUT INVERTER

- A. **General:** 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 percent of system capacity, shall be sustained by the inverter for 30 seconds in normal and battery operation. Overloads of 125 percent shall be sustainable by the inverter for up to 60 seconds. Should overloads persist past

the outlined time limitation; the critical load shall 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.
- D. **Battery Protection:** The inverter shall be provided with monitoring and control circuits to limit the level of discharge on the battery system.

2.5 STATIC BYPASS

- A. **General:** 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. **Design:** The design of the static switch power path shall consist of silicon controlled rectifiers (SCR) with a continuous duty rating of 110 percent 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 percent 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 percent of system capacity for periods of up to 500 milliseconds.
- F. **System Protection:** As a requirement of UL 1778, 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.

2.6 INTERNAL MECHANICAL BYPASS

- A. The UPS shall be equipped with an internal make-before-break bypass switch to isolate the UPS during times where maintenance is required.

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 Owner to display a time and date stamped log for the 64 most recent status and alarm events.
- D. **Alarms:** The display unit shall allow the Owner 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.
- E. **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.
- F. **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 shall indicate the load is being supported by the UPS output.
 - b. **On Battery:** When yellow, this LED shall indicate the UPS is running from battery power.
 - c. **Bypass:** When yellow, this LED shall indicate the load is being supported by static bypass/mechanical bypass.
 - d. **Fault:** When red, this LED shall indicate there is a fault condition present in the UPS.
 2. **Pushbutton User Controls:**
 - a. Up arrow.
 - b. Down arrow.
 - c. Help key.
 - d. Escape key.
 - e. Enter key.
- G. **Potential Free (Dry) Contacts:** 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):
1. Normal operation.
 2. Battery operation.
 3. Bypass operation.
 4. Common fault.
 5. Low battery.
 6. UPS off.
- H. **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 Owner-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 Owner-replaceable, hot swappable, fused, battery modules. Each battery module shall be monitored to determine the highest battery unit 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.

2.9 ACCESSORIES

- A. **Extended Runtime (XR) Option:**
 1. For purposes of extending the UPS battery runtime, external extended runtime options shall be available. The extended runtime option shall be housed in line-up-and-match type 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.
 2. The extended runtime system shall have a 250 volts DC 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 shall be equipped as part of a line-up-and-match type battery enclosure.

B. Maintenance Bypass Cabinet (MBC):

1. The MBC shall provide power to the critical load bus from the bypass source, during times where maintenance or service of the UPS is required. The MBC shall provide a mechanical means of complete isolation of the UPS from the electrical wiring of the installation. The MBC shall be constructed in a freestanding or wall-mounted NEMA 1 enclosure unless otherwise stated in this Section.
2. As a minimum, the MBC shall contain the following features and accessories:
 - a. Circuit breakers of the appropriate size and withstand rating (maximum 25 kAIC rating), for the system.
 - b. Minimum 1A/1B auxiliary contacts for the purpose of relaying status information of the maintenance bypass circuit switch to the UPS.
3. The MBC shall be available in a minimum of two distinct types:
 - a. Wall-mount, three-breaker, NEMA 1 enclosure.
 - b. Line-up-and-match style enclosure. This option shall have pre-formed knock-outs for purposes of top or bottom fed distribution. It shall be available as a standard cabinet, or shall come equipped with a 42 pole distribution panel, or shall be equipped with an input isolation transformer.
4. The MBC shall carry a UL 1778 agency listing.

C. Input Transformer Cabinet (XFM): The input transformer cabinet shall provide isolation or voltage transformation for rectifier input and DC bus for ungrounded DC systems. The input isolation transformers shall be housed in a line-up-and-match type enclosure.

D. Parallel Operation:

1. **General:** For purposes of load-sharing, the UPS shall contain, as a standard feature, the ability to parallel up to four modules for either increased capacity, redundancy, or both. In this mode of operation the output voltage, output frequency, output phase angle, and output impedance of each module shall operate in uniformity to ensure correct load-sharing. This control function shall not require any additional footprint and shall be an integral function of each UPS.
2. **Network:** Communication between modules shall be connected in a multi-drop bus network comprising of two parallel redundant buses so that the removal of any single cable shall not jeopardize the integrity of the parallel communication bus.
3. **Synchronization Bus:** One UPS module shall operate as the master. The master unit shall transmit a signal directly derived from its own phase lock loop (PLL) circuit as the sync clock reference to the slave units to ensure effective synchronization of modules. In the event that the master unit fails, the first slave unit to receive logic power shall assume the role as master.
4. **Load-Sharing:** A load-sharing circuit shall be incorporated into the parallel control communications to ensure that under no load conditions, no circulating current exists between modules. This feature shall also allow each UPS to share equal amounts of the total critical load bus. A UPS module's influence over load-sharing shall be inhibited in any mode where the UPS inverter is not supporting its output bus. Load-sharing communications shall be galvanically isolated for purposes fault tolerance between UPS modules.

E. Parallel System Maintenance Bypass Cabinet (PSMBC):

1. The PSMBC shall provide power to the critical load bus from the bypass source, during times where maintenance or service of the UPS modules is required. The PSMBC shall provide a mechanical means of complete isolation of the UPS module from the electrical wiring of the installation.
2. As a minimum, the PSMBC shall contain the following features and accessories:
 - a. Circuit breakers of the appropriate size and withstand rating (maximum 25 kAIC rating), for the system and each UPS module.
 - b. Minimum 1A/1B auxiliary contacts for the purpose of relaying status information of all PSMBC circuit breakers to the UPS.

- c. Sufficient APC CAN bus PCB's to provide adequate communications of the PSMBC status to the UPS system parallel control system.
 - 3. The PSMBC shall be available as a line-up-and-match enclosure, circuit breaker, NEMA 1 enclosure.
 - 4. The PSMBC shall carry a UL 1778 agency listing.
- F. **Software and Connectivity:**
- 1. **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 RS-232 serial port on the standard communication interface board.
 - 2. **Unattended Shutdown:** 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. The UPS shall also be capable of using an RS-232 port to communicate by means of serial communications to gracefully shut down one or more operating systems during an on battery situation.
- G. **Remote UPS Monitoring:** 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. **RS-232 Monitoring:** Remote UPS monitoring shall be possible via either RS-232 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.
- H. **Software Compatibility:** The UPS manufacturer shall have available software to support graceful shutdown and or remote monitoring for the following systems:
- 1. Microsoft Windows 95/98/XP.
 - 2. Microsoft Windows NT 4.0 SP6/2000.
 - 3. OS/2.
 - 4. Netware 3.2 – 5.1.
 - 5. MAC OS 9.04, 9.22, 10.
 - 6. Digital Unix/True 64.
 - 7. SGI 6.0-6.5.
 - 8. SCO UNIX.
 - 9. SVR4 2.3, 2.41.
 - 10. SCO Unix Ware 7.0 - 7.11.
 - 11. SUN Solaris 2.6-2.8.
 - 12. SUN OS 4.13, 4.14.
 - 13. IBM AIX 4.3x-4.33g, 5.1.
 - 14. HP-UX 9.x-11.i.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. **Verification of Conditions:** Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Architect/Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
 - 1. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.

3.2 INSTALLATION

- A. **General:** Preparation and installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings.
- B. **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:
 - 1. **Visual Inspection:**
 - a. Inspect equipment for signs of damage.
 - b. Verify installation per manufacturer's instructions.
 - c. Inspect cabinets for foreign objects.
 - d. Inspect battery units.
 - e. Inspect power modules.
 - 2. **Mechanical Inspection:**
 - a. Check UPS and external MBC internal power wiring connections.
 - b. Check UPS and external MBC terminal screws, nuts, and/or spade lugs for tightness.
 - 3. **Electrical Inspection:**
 - a. Verify correct input and bypass voltage.
 - b. Verify correct phase rotation of mains connections.
 - c. Verify correct UPS control wiring and terminations.
 - d. Verify voltage of battery modules.
 - e. Verify neutral and ground conductors are properly landed.
 - f. Inspect external maintenance bypass switch for proper terminations and phasing.
 - 4. **Site Testing:**
 - a. Ensure proper system start-up.
 - b. Verify proper firmware control functions.
 - c. Verify proper firmware bypass operation.
 - d. Verify proper maintenance bypass switch operation.
 - e. Verify system set points.
 - f. Verify proper inverter operation and regulation circuits.
 - g. Simulate utility power failure.
 - h. Verify proper charger operation.
 - i. Document, sign, and date test results.
 - 5. **On-Site Operational Training:** During the factory-assisted start-up, operational training for site personnel shall include, but shall not be limited to, key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

3.3 FIELD QUALITY CONTROL

- A. **General:** See [Section 01 45 23 - INSPECTING AND TESTING SERVICES]
[Section 01410 - INSPECTING AND TESTING SERVICES].
- B. **Manufacturer Field Service:**
 - 1. **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.
 - 2. **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 four working hours or on the next available flight, so that the parts may be delivered to the Owner within 24 hours.

3.4 DEMONSTRATION

- A. **General:** Provide the services of a factory-authorized service representative of the manufacturer to provide start-up service and to demonstrate and train the Owner's personnel.

1. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.
2. Train the Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance.
3. Review data in operation and maintenance manuals with the Owner's personnel.
4. Schedule training with the Owner, through the Architect/Engineer, with at least seven day's advanced notice.

- B. **UPS Training Workshop:** A UPS training workshop shall be available from the UPS manufacturer. The training workshop shall include, but shall not be limited to, a combination of lecture and practical instruction with hands-on laboratory sessions. The training workshop shall include, but shall not be limited to, instruction about safety procedures, UPS operational theory, sub-assembly identification and operation, system controls, adjustments, preventative maintenance, and troubleshooting.

3.5 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to the Installer, that shall ensure that the solid state UPS shall be without damage at time of Substantial Completion.

END OF SECTION