

APC by Schneider Electric

APC SYMMETRA MW

800 kW/1000 kW

Uninterruptible Power Supply

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 53] [16611]

STATIC 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 static 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 continuous duty, three-phase, solid state, static UPS.
 - 1. In addition, this Section describes the performance, functionality, and design of the UPS maintenance bypass cabinet, hereafter referred to as the MBC, the battery system, and the UPS static bypass cabinet.
 - 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. 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 891, "Standard for Dead-Front Switchboards" (copyrighted by UL, ANSI approved).
 2. UL 1558, "Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear."
 3. 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 for full kW output in the following sizes:
 - a. 1000 kVA/1000 kW.
 - b. 800 kVA/800 kW.
2. **Input:**
 - a. **AC Input Nominal Voltage:** 480 volts, three-phase, 3 wires, 60 hertz.
 - b. **AC Input Voltage Window:** ± 15 percent of nominal (while providing nominal charging to the battery system).
 - c. **Short Circuit Withstand Rating:** 100,000 symmetrical amperes (100 kA).
 - d. **Maximum Frequency Range:** ± 0.5 percent to 8 percent of nominal.
 - e. **Input Power Factor:** ~ 1 at 100 percent load and shall not be less than 0.97 at loads greater than 25 percent of system rating with no additional filters.
 - f. **Input Current Distortion:** Maximum 5 percent with no additional filters.
 - 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 10 second default time and values from 1 second to 40 seconds shall be programmable.
3. **UPS Output:**
 - a. **AC Output Nominal Output:** 480 volts, three-phase, 3 wires, 60 hertz.
 - b. **AC Output Voltage Distortion:** Maximum 3 percent at 100 percent linear load.
 - c. **AC Output Voltage Regulation:**
 - 1) ± 1 percent for 100 percent balanced linear load.
 - 2) ± 3 percent for 100 percent unbalanced linear load.
 - d. **Voltage Transient Response:**
 - 1) ± 3 percent maximum for 50 percent load step.
 - 2) ± 5 percent maximum for 100 percent load step.
 - e. **Voltage Transient Recovery:** Within 50 milliseconds.
 - f. **Output Voltage Harmonic Distortion:**
 - 1) 3 percent THD maximum and 1 percent single harmonic for a 100 percent linear load.
 - 2) 5 percent THD maximum for a 100 percent non-linear load (no crest factor limitation).
 - g. **Phase Angle Displacement:**
 - 1) 120 degrees ± 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.
 - h. **Overload Rating:**
 - 1) **Normal Operation:**
 - a) 200 percent for 60 seconds.
 - b) 125 percent for 10 minutes.

- 2) **Battery Operation:** 150 percent for 30 seconds.
- 3) **Bypass Operation:**
 - a) 125 percent continuous.
 - b) 1000 percent for 500 milliseconds.
- i. **System Efficiency:** The system AC-AC efficiency shall be greater than 97 percent at 100 percent load and shall not be lower than 94 percent at 25 percent load.
- j. **Output Power Factor Rating:** The UPS output shall not require derating for purely resistive loads (PF of 1). The potential kW and kVA ratings of the UPS output shall be equal. For loads exhibiting a power factor of 0.9 leading to 0.8 lagging no derating of the UPS shall be required. For loads exhibiting power factors outside this range, the following derating shall apply:
 - 1) 5 percent derating of the UPS shall apply for 0.7 PF lagging.
 - 2) 10 percent derating of the UPS shall apply for 0.6 PF lagging.
 - 3) 15 percent derating of the UPS shall apply for 0.5 PF lagging.
 - 4) 20 percent derating of the UPS shall apply for a range of 0.4 PF to 0.1 PF lagging.

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.

- 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.

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. Customer shall provide adequate facility to 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. **Environmental:**
 - a. **Storage Ambient Temperature:** -58 °F (-50 °C) to 131 °F (55 °C).
 - 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 3280 feet (1000 m) above sea level. At higher altitudes the following derating shall apply:
 - 1) 4921 feet (1500 m) derating factor of 0.95.
 - 2) 6562 feet (2000 m) derating factor of 0.91.
 - 3) 8202 feet (2500 m) derating factor of 0.86.
 - e. **Access Requirements:**
 - 1) The UPS shall require front access only for installation and field assembly. Servicing of the UPS shall only require front access for commonly serviced components, such as fuses, power modules, control circuits, contactors, and active components. No top, side, or back access shall be required for servicing said components of the UPS.
 - 2) In addition, power cable for both the UPS AC and DC shall be top and/or bottom entry as standard product and shall be terminated in a designated input/output section of the UPS. It shall be possible to place this input/output cabinet on either the left or right side of the UPS. Replacement of air filters shall not require the system to be placed into maintenance bypass, nor shall it require personnel to be subjected to live potential.

1.9 WARRANTY

- A. **General:** See [Section 01 77 00 - CLOSEOUT PROCEDURES] [Section 01770 - CLOSEOUT PROCEDURES].
- B. **Special Warranty:** The Manufacturer 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 "APC Symmetra MW II" 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 output inverter and input (Delta) converter shall operate in an on-line manner to continuously regulate power to the critical load. The input power converter and output inverter 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 main 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 internal fault in the UPS, this transfer shall be an automatic function.
- D. **Maintenance Bypass:** The UPS system shall be equipped with an external make-before-break 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.

2.3 MODULARITY OF DESIGN

- A. For ease of maintenance, growth, and fault tolerance, the power converters of the system shall be designed in draw-out modules, able to be inserted and removed from the front of the UPS.
- B. Based on this mechanical design, a fault in one converter module shall not influence the operation of the remaining modules of the system. Time coordinated fusing shall be used, along with mechanical contactors for each 200 kW section, to facilitate the rapid removal of a failed section from the input, output, and DC buses, without sacrificing the critical load output bus.
- C. Each 67 kW power converter module shall contain a DC power supply to power the logic and control circuits of each respective 200 kW section. Loss of one DC power supply per 200 kW section shall not influence the performance of that 200 kW section.
- D. Two main redundant power supplies shall also be provided for main logic circuits and interface signals of the UPS. These power supplies shall have fused sections to provide fault containment. These fuses shall have blown indicators to allow for rapid diagnostics and repair by on-site service personnel.
- E. Each 67 kW power module shall contain two redundant cooling fans to take in ambient air through filtered inlets on the front of the UPS. As long as no more than one fan per power module fails, the loss of three fans per 200 kW section shall not cause a derating of the ambient operating temperature of the UPS.

2.4 INPUT POWER CONVERTERS

- 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 output voltage regulation.
- B. **Input Current Total Harmonic Distortion:** The input current THD_i shall be held to 5 percent or less 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, from 0 percent to 100 percent of the UPS capacity. 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 10 second period, (with optional settings ranging from 1 second through 40 seconds), when returning to the AC mains 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:**
 - 1. The input converters shall control and limit the input current draw from utility to 130 percent of the UPS output. During conditions where input current limit is active, the UPS shall be able to support 100 percent load, charge batteries at 10 percent of the UPS output rating, and provide voltage regulation with mains deviation of up to ± 15 percent of the nominal input voltage.
 - 2. In cases where the source voltage to the UPS is nominal (480 volts) and the applied UPS load is equal to or less than 100 percent of UPS capacity, input current shall not exceed 115 percent of UPS output current, while providing full battery recharge power.

2.5 OUTPUT INVERTER

- A. **General:** The UPS output inverters 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 300 percent for short circuit clearing. Steady state overload conditions, of up to 200 percent of system capacity, shall be sustained by the inverter for 60 seconds in normal operation. In battery operation the inverter shall be capable of sustaining 150 percent of system capacity for 30 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:** Each 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 failure of one inverter shall not affect the operation of any other inverter connected to the critical bus.
- D. **Fusing:** Each modular inverter shall have high-speed time and energy coordinated fusing to provide fault isolation between inverters. Based on this feature, a fault within an individual inverter shall not cause a cascading failure of any other inverter connected to the critical bus of the UPS.
- E. **Battery Protection:** The inverter shall be provided with monitoring and control circuits to limit the level of discharge on the battery system. These control circuits shall be capable of varying the shutdown level to accommodate any type of battery recommended for UPS application. These logic and control circuits shall automatically adjust shutdown level to 1.75 volts per cell for any discharge lasting longer than 60 minutes.

2.6 STATIC BYPASS

- A. **General:** As part of the UPS, a system static bypass cabinet 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. The UPS and static bypass switch shall constantly monitor the auxiliary contacts of their respective circuit breakers, as well as the bypass source voltage, and inhibit potentially unsuccessful transfers to static bypass from taking place.
- B. **Design:** The design of the static switch power path shall consist of silicon-controlled rectifiers (SCR) with a continuous duty rating of 125 percent of the UPS output rating. Each set of SCR's shall be protected with time and energy coordinated fuses to limit the I²T to a value less than the I²T rating of the SCR.
- 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 output bus 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 either the UPS touch screen interface or the external static bypass touch screen.
- E. **Overloads:** The static bypass shall be rated and capable of handling overloads equal to or less than 125 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 1000 percent of system capacity for periods of up to 500 milliseconds.

F. **System Protection:**

1. Each phase of the static switch shall be protected by both time/energy coordinated fusing, and circuit breakers. Standard circuit breaker protection shall be of a molded case design; options shall be available for insulated case circuit breakers or draw-out power circuit breakers.
2. 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, the circuit breaker serving as the input disconnect 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.

2.7 DISPLAY AND CONTROLS

A. **Touch Screen Interface:** A touch screen user interface shall be supplied with both the UPS and external static switch cabinets, for the purposes of retrieving information from the UPS/static switch and providing control functionality. As an added feature, intelligent interface between the Owner and UPS shall be accomplished without the use of mechanical pushbuttons or rotary dials. Data transmitted between the UPS/static switch and the user interface shall be transmitted via the system CAN bus.

B. **Mimic Bus:** The touch screen interface default screen shall be a mimic bus of the installation, showing respective circuit breakers connected to the UPS. The mimic bus shall depict power flow through the system and automatically change status to reflect any change in power flow through normal operation, static bypass operation, maintenance bypass operation, or battery operation.

1. The mimic bus power flow highlighting shall also be color-coded green, for power flow through the UPS power conversion path, and yellow for static bypass or maintenance bypass operation. Changes in status of circuit breaker operation shall also be depicted on the mimic bus. The mimic bus shall also provide information such as power flow, voltage and current for the UPS input, output, bypass, and battery.

C. **Metered Data:** The following metered data, shall be available on the UPS touch screen interface:

1. Input current.
2. Input current total harmonic distortion (THD_I).
3. Input crest factor.
4. Input voltage.
5. Input voltage total harmonic distortion (THD_V).
6. Input active power per phase.
7. Input apparent power per phase.
8. Total input active power.
9. Total input apparent power.
10. Input power factor.
11. Output current.
12. Output current Total Harmonic Distortion (THD_I).
13. Output crest factor.
14. Output voltage.
15. Output voltage total harmonic distortion (THD_V).
16. Output active power per phase.
17. Output apparent power per phase.
18. Total output active power.
19. Total output apparent power.
20. Output power factor.
21. Bypass current.
22. Bypass current total harmonic distortion (THD_I).
23. Bypass crest factor.
24. Bypass voltage.
25. Bypass voltage total harmonic distortion (THD_V).
26. Bypass active power per phase.
27. Bypass apparent power per phase.

28. Total bypass active power.
29. Total bypass apparent power.
30. Bypass power factor.
31. DC voltage.
32. DC current.
33. DC power.
34. Estimated charge time.
35. Estimated charge percentage.
36. Run time.
37. UPS temperature.
38. Static bypass temperature.

D. **Alarms:** Alarms shall be visible when active, from the user interface, by one pushbutton sequence on the touch screen interface. The alarm log shall show each entry with corresponding date and time stamp. The level of criticality shall also be displayed with each entry and shall be color-coded green, yellow, or red, based on their respective severity. The following minimum set of alarm messages shall be available to depict the status of the UPS/static switch:

1. High battery temperature.
2. Battery grounding error.
3. Positive battery breaker open.
4. Negative battery breaker open.
5. Low battery warning.
6. High battery warning.
7. Low DC shutdown.
8. High DC shutdown.
9. Battery fault.
10. Input power failure.
11. Main static switch fan fault.
12. Input fuse fault.
13. Input power module section fuse fault.
14. Output fault.
15. Output off.
16. Output fuse fault.
17. Output section fuse fault.
18. Bypass synchronization error.
19. Bypass fault.
20. Bypass static switch fan fault.
21. Bypass static switch fuse fault.
22. Bypass static switch thyristor fault.
23. Bypass static switch back-feed protection activated.
24. Bypass static switch power supply fault.
25. Bypass temperature fault.
26. Inverter temperature fault.
27. Overload.
28. Inverter fan fault.
29. Inverter fuse fault.
30. Inverter fault.
31. EPO activated.
32. Output current limiter active.
33. High delta transformer temperature.
34. High switch choke temperature.
35. Power supply fault.
36. DC fuse fault.

E. **Controls:**

1. Control functions such as start-up, transfer to bypass, and parameter changes shall be accessible from the touch screen user interface. Operations such as start-up, shall have step-by-step instructions from the user interface to ensure correct sequencing of operations. To

further minimize Owner error, the touch screen shall highlight in green, functions that have been completed, and shall inhibit out of sequence operations performed by the Owner. The current step in process shall also be outlined to ensure easy operation. One such user interface shall be part of both the UPS cabinet, and the static bypass cabinet, each sharing similar functions.

2. Intelligent logic shall also inhibit any state change such as "transfer to bypass" in the event bypass is unavailable, or a circuit breaker in the event bypass power path is open. Also available, in addition to the touch screen user interface, shall be three clearly marked buttons, with a clear plastic hinged cover to prevent unintentional operation of such buttons. These buttons shall be located on both the UPS cabinet, and the static bypass cabinet. Their functions shall be as follows:
 - a. **Green Button:** Shall turn UPS output on.
 - b. **Red Button:** Shall turn UPS output off.
 - c. **Yellow Button:** Emergency module off button. Shall trip respective AC Input, output, and DC circuit breakers of that respective UPS.
3. An event log shall record event history that has taken place since the UPS was started, or since the last time the log was erased by the Owner. This log shall provide a date and time stamp of activities and shall be removed in a first-in, first-out format.

2.8 ACCESSORIES

- A. **Battery Disconnect Breaker:** Each UPS system shall have two [____] AF/AT, 500 volts DC rated, thermal magnetic trip molded case circuit breakers. Each circuit breaker shall have a 24 volts DC under-voltage release and 2A/2B auxiliary contacts. The circuit breakers shall be in a separate NEMA 1 enclosure. When open, there shall be no battery voltage in the UPS enclosure. The UPS system shall be automatically disconnected from the battery by opening its breakers, should the UPS be subjected to a low battery shutdown state for an extended period of time, when signaled by a remote EPO signal, or when the EMO button is pressed on the UPS. The battery disconnect enclosure shall also be equipped with the following minimum features:
 1. Controller area network (CAN) card for sending and receiving information to and from UPS.
 2. Lights that illuminate during "safe-to-operate" conditions.

INSERT APPLICABLE VALUE IN SUBPARAGRAPH ABOVE

- 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 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 frame size, withstand rating (kAIC rating), and trip rating for the system.
 - b. Minimum 2A/2B auxiliary contacts for the purpose of relaying status information of each circuit breaker to the UPS and static bypass.
 - c. CAN interface circuit card to provide an intelligent interface between the switchboard/switchgear enclosure.
 - d. Plated copper bus bar, braced for the appropriate withstand rating of the system.
 3. The following minimum options shall also be available for the MBC:
 - a. Key interlock to prevent out of sequence transfers of MBC from normal operation to bypass operation.
 - b. Solenoid key release unit (SKRU).
 - c. Mimic bus with light indications for power flow.
 - d. Electrically operated circuit breakers.
 - e. Load Bank Breaker
 4. The MBC shall carry one of the following agency listings:
 - a. UL 891.

- b. UL 1558.

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. Verify correct electrolyte level of flooded cells (if applicable).
 - e. Inspect battery cases.
 - f. Inspect batteries for proper polarity.
 - g. Verify printed circuit boards are properly configured.
 - 2. **Mechanical Inspection:**
 - a. Check UPS, external maintenance bypass cabinet, and DC circuit breaker cabinet internal control wiring connections.
 - b. Check UPS, external maintenance bypass cabinet, and DC circuit breaker cabinet internal power wiring connections.
 - c. Check UPS, external maintenance bypass cabinet, and DC circuit breaker cabinet terminal screws, nuts, and/or spade lugs for tightness.
 - 3. **Electrical Inspection:**
 - a. Check UPS fuses for continuity.
 - b. Verify correct input and bypass voltage.
 - c. Verify correct phase rotation of mains connections.
 - d. Verify correct UPS control wiring and terminations.
 - e. Verify correct termination and voltage of battery strings.
 - f. Verify neutral and ground conductors are properly configured.
 - g. 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 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, and preventative maintenance.

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