PART 1 – GENERAL

1.01 SECTION INCLUDES

A. System requirements.
B. Rectifier/charger.
C. Inverter.
D. Static transfer switch.
E. External maintenance bypass cabinet (MBC).
F. Batteries.
G. Controls.
H. Metering.
I. Indicators.
J. Remote monitoring.

1.02 RELATED SECTIONS

A. Section 26 33 01, DC Batteries
B. Train Control UPS Single-Line Diagram, Typical, Standard Drawing ES70
C. Emergency Lighting UPS Single-Line Diagram, Typical, Standard Drawing ES71

1.03 MEASUREMENT AND PAYMENT

A. Separate measurement and payment will not be made for the Work required under this Section. All costs in connection with the Work specified herein will be considered to be included with the related item of Work in the Bid Schedule of the Bid Form, or incidental to the Work of the Contract.

1.04 SUBMITTALS

A. General: Refer to Section 01 33 00, Submittal Procedures; Section 01 33 23, Shop Drawings, Product Data, and Samples; and Section 01 78 23, Operation and Maintenance Data for submittal requirements and procedures.
B. Submit product information and catalog cuts of UPS equipment components and devices.
C. After the receipt of Notice To Proceed, submit within three weeks required drawings and specifications for review.

D. Include as Shop Drawings:
   1. Equipment dimensions, weights, and heat description
   2. Performance curves for range of operation
   3. System configurations with single-line diagram
   4. Installation requirements and layouts
   5. Details of construction
   6. Technical data sheets
   7. Wiring diagrams
   8. Detailed layouts of power and control connections
   9. Detailed installation drawings including terminal locations
  10. Air flow requirements

E. Submit UPS system specifications to the Engineer.

F. Review of Shop Drawings by the Engineer for general conformance only and shall not relieve the Contractor of responsibility for supplying equipment which complies with the specifications and functional requirements and good engineering practice.

G. Submit a copy of the factory test report to the District, two (2) weeks prior to the shipment of the equipment in accordance with Section 20 72 25, Factory and Field Testing.

1.05 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI C84.1 Electric Power Systems and Equipment – Voltage Ratings (60 Hertz)

B. International Electrotechnical Commission (IEC):
   1. IEC 60068-1 Environmental Testing Part 1: General and Guidance

C. Institute of Electrical and Electronic Engineers (IEEE):
   1. IEEE C62.41 IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
2. IEEE 446  
IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications

3. IEEE 1184  
IEEE Guide for Batteries for Uninterruptible Power Supply Systems

D. Federal Communications Commission (FCC):

1. FCC Rules and Regulation 47, Part 15  
Radio Frequency Devices

E. National Electrical Manufacturers Association (NEMA):

1. NEMA PE-1  
Interruptible Power Systems (UPS)- Specification and Performance Verification

2. NEMA AB-1  
Molded Case Circuit Breakers

3. NEMA 250  
Enclosures for Electrical Equipment (1000 Volts Maximum)

F. InterNational Electrical Testing Association (NETA):

1. NETA ATS  
Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

G. National Fire Protection Association (NFPA):

1. NFPA 70  
National Electric Code

2. NFPA 110  
Standard for Emergency and Standby Power Systems

H. Underwriters Laboratory, Inc. (UL):

1. UL 924  
Standard for Emergency Lighting and Power Equipment

2. UL 1778  
Standard for Uninterruptible Power Systems

I. Telecommunications Industry Association (TIA):

1. TIA-232  
Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

2. TIA-485  
Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

1.06  
WARRANTY

A. UPS: The warranty shall be for 24 months after Acceptance and shall include all costs for repair, parts, labor, travel and living expenses for the manufacturer’s service personnel. Under conditions where the UPS is determined to be
unrepairable, the manufacturer shall replace it with a new UPS with comparable specifications.

B. Refer to Section 26 33 01, DC Batteries for warranty on batteries.

C. The manufacturer shall dispatch the technician(s) within 72 hours after the warranty call is requested.

1.07 QUALITY ASSURANCE AND QUALITY CONTROL

A. Manufacturer Qualifications: Company specializing in UPS equipment with a minimum of five (5) years experience in the design, manufacturing, and testing of the UPS systems.

B. Factory Testing: The manufacturer shall fully and completely test the system to assure compliance with the specifications, before shipment.
Figure 1: Typical Train Control UPS System Single-Line Diagram
PART 2 – PRODUCTS

2.01 SYSTEM REQUIREMENTS

A. General:

1. The UPS system shall consist of the UPS cabinet, isolation transformers, maintenance bypass cabinet (MBC), static transfer switch, battery assembly and the other features described in the specifications and shown on block diagram Figure 1.

2. UPS Equipment shall be provided by one manufacturer.

3. Testing of UPS Equipment is to be conducted at the Jobsite with the UPS systems fully assembled.

B. Modes of Operation:

1. UPS

   a. The UPS shall be an on-line type and make-before-break operation during load transfer.

   b. Normal operation: Under normal operation the power shall be transferred through the UPS converter systems. The output AC voltage shall be fully regulated; the output shall be isolated from the input through an isolation transformer.

   c. Loss of normal input power: Upon loss of input AC power, there will be no interruption of power as the UPS inverter shall continue to power the load from stored battery system’s DC bus. The battery shall continue to supply power to the inverter at rated full load for the specified time as indicated.

   d. Return of Normal Power: The UPS system shall automatically return to normal operation as described in (b) with no interruption to essential loads. The transfer to normal utility power will be initiated only after ascertaining stable return of input AC voltage after several cycles.

   e. UPS internal fault: When there is failure in the UPS inverter or the battery system unable to supply power, a control signal shall inhibit the inverter operation and the power will continue to be transferred from input AC to the output through the static bypass switch as indicated in Figure 1.

   f. UPS replacement/maintenance: In the event the UPS needs to be replaced, the input external bypass switch shall be closed and output disconnect switch shall be opened manually. This will allow total bypass of the UPS for safe removal as indicated in Figure 1.

   g. Operation without batteries: If the battery is taken out of service, the UPS shall continue to function from the input AC source through static bypass or external mechanical bypass switch.
C. **Power Rating:**

1. The UPS shall be sized in accordance with the District-approved power calculations to support the connected load with a minimum of 20 percent margin of UPS rating. The input line voltage, load voltage, and input bypass line voltage shall be as indicated.

2. The UPS battery shall have capacity as indicated.

D. **Electrical Requirements:**

1. Acoustical Noise: 65 dBA max, measured at 1 meter from the nearest surface of the cabinet.

2. EMI Suppression: Comply with FCC rules and regulation 47.

3. Electrostatic Discharge (ESD): The UPS shall withstand up to 25KV without damage and with no disturbance or adverse effect to the critical load.

4. Efficiency: 80 percent minimum at 50 percent load.


6. Short Circuit Current Rating: UPS shall have 65KA short circuit withstanding rating.

E. **Input Ratings:**

1. Input voltage: As indicated.

2. Input Voltage Range: +15 percent to -15 percent

3. Input Frequency Range: 53 to 67 Hz

4. Phase Unbalance: The UPS shall not be impacted by input line phase unbalance up to plus or minus 10 percent. The output phase unbalance shall not be contributed by the UPS inverters.

5. Power Factor: 0.8

6. Current Limit: 125 percent full load maximum

7. Protection: The unit shall be self protected against unwanted over-voltage including line over-voltage and transients such as switching surge and lightning, over-current including short circuits as indicated in Figure 1.

8. Inrush current: Soft start shall be used to limit no more than 1.5 by full load for a duration not exceeding 100 milliseconds.
9. **Input Transformer:** Delta: Y Shall be electrically isolated and copper windings.

10. **Isolation:** Input shall be isolated from the AC system by an isolation transformer as indicated. The isolation voltage of the transformer shall be per applicable standards.

11. **Total Harmonic Distortion (THD):** less than 5 percent

F. **Output Rating:**

1. **Output Voltage Rating:** As indicated.
2. **Output Power Rating:** As indicated.
3. **Output Voltage Regulation:** Within plus or minus 2 percent of output voltage
4. **Output Frequency:** Nominal 60 Hz, plus or minus 0.5 Hz
5. **Load Response:** 1 millisecond
   a. Free running stability: Plus, or minus 0.15 percent in 24 hours
   b. Stability: Plus or minus 1 percent in 6 months
6. **Voltage Transients:**
   a. Voltage transient shall not exceed plus or minus 5 percent for any change in load.
   b. Return of AC Power: Plus or minus 2 percent
   c. Manual transfer of load: Plus or minus 5 percent
   d. Automatic transfer of load shall have transient suppression network as well as suppressors.
7. **Voltage transient recovery time within 2 percent within 1 millisecond.**
8. **Load power factor:** 0.8 lagging to 0.8 leading
9. **Total Harmonic Distortion (THD):** less than 3 percent RMS maximum; less than 2 percent any single harmonic
10. **Overloads:** 125 percent for 10 minutes; 115 percent for 1 hour
11. **Static transfer:** 1000 percent full load for 1 switch loading cycle; 200 percent full load for 5 minutes
12. **Hours of operation:** 8 hours for train control and communication loads, 90 minutes for the emergency lightings, and other BART facilities as indicated.
13. Output Transformer: Secondary Y configuration shall be electrically isolated and copper windings

14. Maximum cabinet size: As indicated.

15. Phase unbalance: 100 percent (e.g. Phase A-10 percent, phase B-80 percent, phase C-10 percent)

G. Controls Design and Operating Characteristics:

1. Fully automatic operation of each UPS module shall be provided through the microcontrollers.

2. Operating and protection parameters shall be firmware controlled to minimize the need for manual adjustments. Adjustments and calibrations shall be performed once at production and at any time the operational parameters are modified. Replacement circuit boards shall be provided with minimum calibration requirements.

3. Start up and transfer shall be automatic functions.

4. Multiple microcontrollers shall be used per module.

5. Configurations, setup, and calibration information shall be stored in non volatile memory.

6. Emergency transfer to bypass due to UPS module failure shall be independent of control logic controlling the rectifier/charger, inverter, and monitor panel.

7. Monitoring and communication logic shall be independent of rectifier/charger and inverter control logic. Circuitry and firmware required for monitoring and communications shall be functionally isolated from the bypass, rectifier/charger, and inverter controls. Monitoring firmware shall be field upgradeable.

8. The UPS module shall be programmable to optionally provide automatic restart capability following loss of utility and complete battery discharge. When utility power returns, the UPS module shall automatically energize the output terminals and subsequently transfer to normal operation.

9. The UPS module shall be able to accept dry contacts and RS-485 signals. The UPS module shall be programmable to deactivate the battery charging upon receiving external signals, including but not limited to exhaust fan failure, hydrogen detected, and high temperature. Discharging from battery system to UPS inverter shall still be active while the battery charger is deactivated.

10. The IP addressable Ethernet (TCP/IP) and parameters shall be made available both locally and remotely. The remote Ethernet (TCP/IP) interface shall be for remote monitoring purposes.
11. IP Addressable Remote Interface:

Remote signals I/O (Input/Output) signals shall interface with Ethernet (TCP/IP). The remote monitored signals shall be as follows:

a. Input current
b. Input voltage (line-line, line-neutral)
c. Output current
d. Output voltage (line-line, line-neutral)
e. UPS fault
f. Low battery voltage
g. Low battery shut down
h. Input AC power failure
i. UPS on static bypass mode

H. Environmental Requirements:

The UPS shall withstand any combination of the following external environment conditions without operational degradation.

1. Operating temperature: 32 degrees to 120 degrees Fahrenheit (0 degrees to 50 degrees Celsius)
2. Relative Humidity: 0 percent to 95 percent non condensing (operating and storage)
3. Elevation: 1000m above mean sea level without derating

I. Reliability and Maintainability:

1. The calculated MTBF for the UPS shall be no less than 150,000 hours.
2. Power cables to power transformer and chokes shall be secured with permanent cold weld crimps, that require no maintenance or periodic retorquing.
3. Maintainability: Mean-time-to-repair (MTTR) shall not exceed one (1) hour, including the time to diagnose the problem and replace the sub assembly.

J. Manuals:

1. Refer to Section 01 78 23, Operation and Maintenance Data for requirements.
2. Manuals shall include:
   a. Clear and permanent identification on the outside of the binder
   b. Detailed index
c. Documentation to be 8 ½-inch by 11-inch format

d. List of supplier and authorized service representatives for the equipment and accessories supplied. Provide names, address and phone numbers

e. Warranty details

f. List of recommended spare parts

g. Step by step start up and shut down procedures

h. Troubleshooting summary

i. Itemized maintenance schedule for daily, weekly, monthly and yearly maintenance

j. Parts summary including make, model and part number

k. Dimensioned general arrangement drawings

l. Parts diagram and assembly drawings to permit tear down maintenance and/or repair

3. Documentation for purchased components not manufactured by the manufacturer.

4. Manuals for software shall include installation specific or proprietary software necessary to maintain, reload or modify the system. Include latest hard copy and soft copy of software.

2.02 EQUIPMENT REQUIREMENTS

A. General

The UPS shall be designed to operate in a non air conditioned room environment with temperature extremes of 32 degrees Fahrenheit and 120 degrees Fahrenheit (0 to 50 degrees Celsius) and humidity 0 percent to 95 percent non condensing. The UPS circuit shall be of modular design for ease of replacement. The system shall have the capability of remote management and monitoring.

1. Modules shall be standardized such that least replaceable unit (LRU) modules shall fit in the same slot without any need of modifications.

2. Removal of critical components shall be easily accessible for maintenance. Critical components shall be configured for self-diagnosis. LED indicators shall light up and alert technician to system faults. Serviceable parts shall be designed to physically separate high voltage areas to assure safety of maintenance personals.

3. The UPS system shall include sub systems as indicated in Figure 1. This shall include the control protection and monitoring circuits. Any deviation from these specifications shall require BART Engineering’s approval.
4. High stress, high voltages electronics switching components shall be plug and play for the ease in service and maintenance.

5. The cooling fans shall be able to replace easily. Upon detection of the cooling fans failure, audible alarms to be sounded and visual alarms to be displayed on the UPS control panel. Fan failure and alarms shall be shown on the remote monitoring system also.

B. **Rectifier/Charger:**

1. The rectifier/charger shall convert incoming AC power to regulated DC output for supplying the inverter and for charging the battery bank. The rectifier shall be twelve-pulse system with silicon-controlled rectifier (SCR) design or insulated-gate bipolar transistor (IGBT) design. The modular design of the UPS module shall permit easy removal of rectifier/charger without removal of any other assembly.

2. The rectifier/charger shall automatically boost the charge to the battery after battery is drained. The boost charge shall allow a quick recharge and keep batteries in good condition without providing a constant float charge. It shall provide a controlled charging and load exercising of batteries to avoid battery deterioration. Controlled charging of the batteries shall prevent boiling and dehydration of electrolyte. Load exercising of the batteries shall keep batteries continuously cycled, alleviating cell deterioration. To prevent overcharging the boost charge shall stop when ambient temperature could cause damage to the batteries.

3. The charger shall be able to recharge the fully discharge battery to 95 percent state of charge (SOC) in 18 hours.

4. The charger unit shall be programmable and expandable for additional battery modules as indicated.

5. The rectifier/charger shall be furnished with output filtering to limit the ripple currents into the battery.

C. **Inverter:**

1. The inverter shall be high frequency switching converter that implements insulated-gate bipolar transistor (IGBT) technology. The inverter shall have the following features:

   a. The inverter shall be capable of providing the specified quality output power while operating from any DC voltage source (rectifier or battery) within the specified range.

   b. The modular design of the UPS shall permit easy removal of each phase of the inverter and DC electrolytic capacitors without removal of any other assembly.

2. The inverter shall have necessary input/output filtering and circuit for regulation, protection, and monitoring.
3. The DC input of the inverter shall have banks of filter capacitors. The loss of one bank shall not disrupt output voltage or a continued full load operation.

4. Protection:
   a. The inverter output shall be protected against over current (OC) and shall have current limiting circuit.
   b. The inverter input shall have surge protection.
   c. The inverter shall have an active soft start circuit to ramp up to full output voltage within 1 second.
   d. The circuitry shall automatically synchronize and phase lock the inverter output to the alternate power source as long as the source is within plus or minus 0.5 at 60 Hz. If the alternate source is not within these limits, then the inverter shall lock to an internal oscillator.
   e. The inverter shall automatically turn off at the DC voltage low level of 1.75 volts per cell.
   f. Test points and LEDs shall be provided to facilitate adjustments, diagnostics, and identify circuit integrity.
   g. It shall be possible to test logic circuitry without operating the power circuits.

D. **Internal Bypass (Static Transfer Switch):**

The bypass shall serve as an alternate source of power for essential loads when a failure prevents operation in normal mode. A static transfer switch consisting of silicon-controlled rectifier (SCR) shall be provided for automatic/manual transfer of loads from the inverter to the alternate power source. The static bypass switch shall only be required for controlling make before break transfer. The operation of the transfer switch shall be as follows:

1. Uninterrupted transfer to static bypass shall be automatically initiated for the following conditions, at the same time turning off the inverter. The transfer shall be inhibited, if the alternate power source is not within specifications.
   a. Inverter under-voltage
   b. Inverter over-voltage
   c. Inverter overload
   d. Inverter cabinet over temperature conditions
   e. Total battery discharge
   f. UPS module failure
   g. Manual initiation
2. Retransfer to Inverter: The static transfer switch shall be capable of automatically retransferring the load back to the inverter after the inverter has returned to normal operating conditions. Uninterrupted automatic retransfer shall take place whenever the inverter is capable of assuming the critical load.

3. Uninterrupted automatic retransfer shall be inhibited for the following conditions
   a. UPS module failure
   b. In the event of multiple transfer-retransfer operation of the control circuitry shall limit to three operations in any 10 minute period. The fourth transfer shall lock the critical load to the bypass source.

4. Transfer and re-transfers shall be inhibited for the following conditions
   a. Frequency out of limits by plus or minus 0.5 Hz
   b. Bypass out of synchronization
   c. Bypass phase rotational/installation error

5. The bypass shall be manually energized with a breaker internally mounted. No additional control logic shall be required.

6. The control circuitry required to perform an emergency transfer to bypass shall operate independently from the inverter control circuitry.

7. The rectifier/charger input circuit breaker shall have no effect on bypass operation.

8. Over current protection: Fuses shall be placed in the inverter input of the static transfer switch of both sources.

9. Surge protection: The static transfer switch shall have surge protection on the alternate source side.

E. External Maintenance Bypass Cabinet (MBC):

1. A manually operated bypass switching arrangement shall be provided to permit transferring the essential loads to the alternate power source, without interruption of power and at the same time to electrically isolate the UPS.

2. The manual bypass switch shall be electrically interlocked to prevent, back feeding the UPS output in the event of incorrect operation, e.g. transferring the load to bypass switch when the load supplied by the inverter.

3. UPS shall initiate an audible alarm upon the transfer to manual bypass. The alarm shall continue to sound while in bypass mode. This shall provide reminder to the user that load continues to be powered from utility or generator supply alone. The audio alarm shall be capable of being muted by the user. The UPS shall have indicator light that shall remain lit even if the alarm is muted when the UPS is in bypass mode.
4. The MBC input and output shall have transient surge protection.

5. MBC shall have the following:
   a. Cabinet Type: NEMA 1, unless otherwise noted
   b. Input AC Voltage: As indicated
   c. Output AC Voltage: As indicated
   d. Cooling: Natural convection with louvers
   e. Input/Output Connections: Terminal blocks
   f. Warranty: Same as UPS

F. Batteries:

Batteries, battery racks/enclosures, and accessories shall be in accordance with the requirements specified in Section 26 33 01, DC Battery System.

1. Battery testing: The UPS shall perform automatic battery test once a week and allow for user remote and local access to selected battery tests. The test shall not compromise the output of UPS system and alert users through a local and remote monitoring system of any battery error.

2. Battery contactor: The UPS shall contain a two pole contactor for disconnecting the battery from the rectifier output and Inverter input. A contactor enabled switch shall be located on the UPS module control panel. With the UPS module in bypass mode, the contactor shall permit the rectifier, inverter, DC capacitors and associated boards to be safely serviced without opening an external battery breaker.

3. Battery Management System: The UPS shall contain a battery management system that has the following features:
   a. The battery management shall provide battery time available, or percent remaining, while operating in normal mode and battery mode. Battery time available shall be displayed in real time, even under changing load conditions. The battery time available information shall be within plus or minus 3 percent.
   b. The battery management system shall automatically analyze the UPS battery during a user defined periodic test. During the test, rectifier/charger shall not de-energize, but shall share load with the battery. For remaining battery time information, the battery shall test under the same load for each user defined periodic test. If the battery is weak or defective, the battery management system shall detect and annunciate the battery failure condition without transferring the critical load to the bypass.
   c. The periodic test performed by the battery management system shall not remove more than 10 percent of the available run time from the battery. The periodic test, if performed monthly basis, shall not reduce overall battery life.
d. If the utility outage occurs while a test in progress, the test shall be discontinued, and subsequently conducted at the next programmed interval. The occurrence of the test shall be user programmable for day, date, and time.

e. The battery management system shall record and display the pass/fail status, battery voltage, and indicator value of previous 30 periodic tests.

f. The battery management system shall announce a user programmable battery time remaining warning when the UPS is on the battery power.

g. The battery management system shall provide an imminent shut down alarm to signal a low battery condition.

h. The battery management system shall work with either wet cell batteries or valve regulated batteries.

i. The battery management system shall only place a charge on the batteries when the system detects a low battery condition or once a month (programmable). Charging and cycling in conjunction with the rectifier to cycle the batteries and preserve the life of the batteries.

j. Charging current and time fully programmable.

G. **Wiring Terminals:**

1. The UPS shall contain mechanical ratcheting compression terminals adequately sized to accommodate 75 degrees Celsius wiring for securing user wiring to the following locations:

   a. Rectifier/charger connections
   b. Bypass connections
   c. DC link connections
   d. AC output connections
   e. Transformer connections

H. **Controls:**

The UPS system shall be furnished with the following controls on or inside the UPS module cabinet.

1. **Rectifier/Charger**

   a. Input non-automatic disconnect
   b. DC float voltage adjustment
   c. DC boost (equalize) voltage adjustment
   d. Boost (equalize) voltage timer adjustment
   e. Boost (equalize) voltage initiation
f. Boost (equalize) voltage timer reset

2. Inverter
   a. Inverter start
   b. Inverter stop
   c. DC under-voltage shut off adjustment
   d. Output AC voltage adjustment

3. Static transfer switch
   a. Transfer switch test
   b. Transfer switch setting adjustment
   c. Maintenance transfer switch

I. Metering:

The following parameters shall be individually metered with a digital read out and with an accuracy of 2 percent or better:

1. DC voltage, Rectifier/charger

2. Direct current: Rectifier/charger

3. AC voltage
   a. Input
   b. Output

4. Alternating current

5. Inverter

6. Alternate power source

7. Load

8. Frequency

J. Indicators:

1. Monitoring components: The following components shall provide monitor and control capability
   a. Micro-controller driven circuitry
   b. Monitor panel with status indicators
   c. Alarm and metering display
d. Various communication ports

2. **Monitor Panel Indicator:** The UPS module shall be equipped with a monitor panel providing the following monitor functions and indicators. Each alarm and notice condition shall be accompanied with an audible alarm.

   a. **NORMAL:** This indicator shall be lit when the UPS module is operating in Normal mode.

   b. **BATTERY:** This indicator shall be lit when the UPS module is operating in Battery mode. The Normal Indicator remains lit.

   c. **BYPASS:** This indicator shall be lit when the UPS module is operating in Bypass mode. The critical load is supporting by the Bypass source. The Normal indicator shall not be lit when UPS is in Bypass mode.

   d. **NOTICE:** This indicator shall be lit when the UPS module need attention. Some notices may be accompanied by an audible alarm. Notice shall include:

      1) Bypass not available
      2) Battery under voltage

   e. **STANDBY:** This indicator shall be lit when electricity is present in the rectifier and inverter. The normal indicator shall not be lit. During the start up this indicator remains lit until the UPS transfer to normal mode, at which time the normal indicator shall lit. During the shutdown the standby indicator shall remain lit until all the energy in the UPS module is dissipated and shut down is complete.

   f. **ALARMS:** This indicator shall be lit when the UPS module need immediate attention. Alarms in the form of flashing displays, shall be provided for the abnormal conditions specified below. Auxiliary contacts shall be provided for each abnormal condition as well as a summary alarm contact for connection to SCADA. Circuitry shall be provided for one TIA-232 and one TIA-485 communication port. Provide one Ethernet (TCP/IP) I/O Base T, RJ45 connection for remote monitoring. The system shall be IP enabled. Alarm contacts shall latch until reset.

      1) Low battery voltage and check battery
      2) Over-temperature in the battery enclosure area
      3) DC over-voltage
      4) DC ground
      5) Alternate power source (internal bypass)
      6) Static transfer switch position (in alternate power source)
      7) Fan failure
      8) Maintenance transfer switch position-ON (MBC external bypass)
      9) Battery carrying the load

   g. **ALARM SILENCE BUTTON:** Display panel shall include alarm reset button. If the alarm reset button is pressed for 1 second, the current audible alarms
shall be disabled. If a new alarm occurs, or a cancelled alarm condition disappears and re-appears, then the audible alarm shall be re-enabled.

h. AUTOMATIC MESSAGING SYSTEM: A means shall be provided to generate automatic dial signal for telephone and other messaging in the event of input AC power failure to UPS and a failure of the UPS itself.

K. Enclosure:

1. Rectifier/charger, inverter, filtering, surge protection shall be installed in NEMA 1 cabinet.

2. The enclosures shall be designed for industrial applications in accordance with the environments requirements. The enclosures shall line up and match up in style and color.

3. Ventilation: The UPS shall be design for forced air cooling. Air inlets shall be in the lower front. Air outlet shall be in the as specified in the contract documents such as rear or the top. Twelve inches of clearance over the UPS air outlets shall be required for proper circulation. Air filters for the UPS shall be commonly available sizes and shall be easily removable from the base.

4. No back or side clearance shall be required for any enclosure. The back and side enclosure covers shall be capable of being located directly adjacent to a wall.

5. Cooling Fans: The modular design to the UPS module shall permitted removal of each fan without the removal of any other assembly. Fan replacement shall be accomplished by removing no more than one fastener per fan and shall not require the removal of another sub assembly.

6. Cable entry: As specified in the contract documents such as top, bottom or side. A dedicated wire way shall be provided within the UPS for routing user input and output wiring. All wiring compartment to meet NFPA 70, NEC size requirements for cable turning radius.

7. Front Access: Serviceable equipment shall be modular and capable of being replaced from the front of UPS. Side or rear access to UPS module shall not be required for UPS installation, service, repair, or maintenance.

PART 3 – EXECUTION

3.01 FIELD QUALITY CONTROL AND COMMISSIONING

A. The following test shall be performed by the field service personnel during the UPS start up:

1. **Visual inspection:**
   
a. Visually inspect equipment for signs of damage and foreign materials.
b. Observe the type of ventilation, cleanliness of room, the use of proper signs, and any other safety related factors.

2. **Mechanical inspection:**
   
a. Check all the power connections for tightness.

2. b. Check all the control wiring terminations and plugs for the tightness or proper seating.

3. **Electrical pre check:**
   
a. Check the DC bus for the possible short circuit.

3. b. Check the input and the bypass for the proper voltage and phase rotation.

3. c. Check all test functions.

4. **Initial Start up:**
   
a. Verify that all the alarms are in a go condition.

4. b. Energized the UPS module and verify the proper DC, walkup, and AC phase on.

4. c. Check the DC link voltage, AC output voltages, and output waveform.

4. d. Check the final DC link voltage and inverter AC voltage output. Adjust if required.

4. e. Check for proper synchronization.

4. f. Check the voltage difference between the inverter output and bypass source.

B. The UPS power equipment manufacturer/Supplier representative shall be an integral part of the project commission team. The UPS power equipment representative shall attend the regular schedule commissioning meetings to assist in start up scheduling and resolve system installation conflicts prior to actual start up.

3.02 **TRAINING**

A. Refer to Section 01 79 00, Demonstration and Training for requirements.

3.03 **SPARE PARTS LIST**

UPS supplier shall provide a recommended spare parts list.

**END OF SECTION 26 34 37**