

SECTION: 2.17

UNINTERRUPTED POWER SYSTEM

1.0 **The Scope**

1.1 The scope of work shall cover supply, erection, testing and commissioning of a static Uninterrupted Power Systems meeting the performance criteria listed in the Data sheets and the specifications. Units may be single or multiple modules as defined in the Data sheets.

2.0 **Code & Standards**

2.1 UPS shall be standard products of established manufacturers and shall meet international standards with UL or CSA or CE listing. Safety & EMC standards should conform to EN 50091 – 1 & 2

3.0 **Environment**

3.1 Design ambient operating conditions shall be

Dry bulb	0 to 40°C
RH	0 to 95% (non-condensing)
Altitude	1000m above mean sea level (Derate for higher levels)

3.2 Transport & storage conditions shall be

Dry bulb	0 to 70°C
RH	0 to 95% (non-condensing)
Altitude	12000m above mean sea level

3.3 Acoustic performance of the units shall meet DIN 45630.

4.0 System Content & Configuration

4.1 General

4.1.1 UPS may have single module or may consist of multiple modules. Each module shall be supported by a back up battery. In multimodule parallel redundant systems, only one of the modules needs to be redundant in a $n + 1$ configuration. Each module shall be rated for continuous operation at 100% load with over load capability as specified and shown in the data sheets. Bypass section both for static and maintenance, shall be integral with each module.

4.1.2 Each module essentially shall consist of A.C input section, AC output section, Bypass section and a back-up battery section and a control and monitoring panel.

4.2 AC Input section

4.2.1 The AC input power supply is from the utility and the characteristic is defined in the Data sheets. Rectifier shall be IGBT based and shall meet the full load + the quick charging current of the battery. Input current limit shall be adjustable to maximum of 125% of normal full load current. The input circuit breaker shall therefore have trip rating to supply full rated load and recharge the battery at the same time. The breakers shall have an under voltage release to open automatically when the supply voltage is lost.

4.2.2 Input Current distortions shall be limited to the values set in the data sheets. Likewise the input power factor shall be as high as possible and not less than what is stated in the data sheets. In addition, the section shall sustain input surges without damage and in this connection it is desirable to follow the criteria listed in ANSI C62.41 – 1980.

4.3 AC Output section

4.3.1 The inverter shall be solid state, pulse width modulated utilizing insulated gate bipolar transistors. Each power IGBT shall be individually fused with a fast acting fuse. Fuse failure shall be displayed in the monitor.

- 4.3.2 Inverter shall be rated for 100% continuous load at 40°C ambient temperature, for any combination of linear or non-linear loads and 10 times continuous load for 3 cycles without causing the bypass breaker to close. For parallel operation, all inverter modules shall automatically share the load within $\pm 5\%$ unbalance. Parallel load sharing function shall be resident and redundant in each unit without requiring master controllers.
- 4.3.3 AC output from the inverter shall be better than what is specified in the data sheets. Voltage distortion, voltage transients, over load performance shall all be good for any load characteristic, linear / nonlinear or any load power factor between 0.5 lagging to 0.9 leading. Provide necessary filters to achieve THD specified in data sheets.
- 4.3.4 A dry type isolation transformer with double shielded copper windings with input and output surge suppression network shall be provided for true galvanic isolation. The transformer shall employ class H 220°C insulation but the maximum temperature rise shall not exceed 150°C. The rating of the transformer shall match with inverter rating and shall have six full-capacity primary taps (+2 ½ , + 5, - 2 ½ , - 5, 7 ½ , 10) Noise / transient suppression shall be not less than 140dB for common mode and 90dB for normal mode. Acoustic noise should not exceed 50 dB at 1.5m and also meet DIN 45630.
- 4.3.5 An automatic output circuit breaker shall be provided to isolate the malfunctioning module from the critical load. The module should sustain sub cycle current of 300 to 500% and in the case of a sustained short circuit, the inverter shall disconnect automatically from the load bus. An uninterrupted load transfer to by pass shall be initiated should connected critical load exceed the capacity of the available on-line modules.
- 4.3.6 UPS should have low ripple & temperature compensated charging facility.

4.4 **Bypass Section**

- 4.4.1 A static transfer switch and bypass circuit shall be as far as possible, an integral part of the UPS. The static switch is a naturally commutated high speed static device rated to conduct 125% of full load current continuously, 200% for 30 seconds and 2000% for two cycles. The static switch may be provided with a wrap-around contactor as necessary.

- 4.4.2 The UPS shall track the bypass continuously so that the bypass source maintains a frequency of 50 ± 0.5 Hz. The inverter will change its frequency at 0.1 Hz per second to maintain synchronous operation with the bypass to enable make before break transfer manually or automatically. If the bypass fails to maintain the frequency, the inverter shall revert to a temperature compensated internal oscillator and hold the inverter output frequency 0.1% from the rated frequency for steady state and transient conditions. Total frequency deviation, including short time fluctuations and drift shall not exceed 0.1% from rated frequency.
- 4.4.3 A manually operated maintenance bypass switch shall be incorporated to each module.
- 4.4.4 Neutrals of all isolation transformers shall be connected to a common earth bus which in turn shall be connected to the earth stations
- 4.5 **Back-up Battery**
- 4.5.1 Each UPS module shall have a matching battery power pack housing sealed valve-regulated preferably with plant's lead acid cells for quick discharge. AH rating of the battery pack shall be such as to sustain full load of the UPS for the specified discharge period till 1.7V cell voltage.
- 4.5.2 Recharge time to 95% capacity shall be within 10 times the discharge time. A 2-step battery charge current shall be limited to 10% (1 – 25% adjustable) and 1% (1 – 25% adjustable). Batteries shall have minimum 5 yrs life.
- 4.5.3 VRLA batteries shall be with flame retardant container material.
- 4.5.4 Insulation of inter-cell connectors for batteries shall be of FRLS type, also battery terminals shall have FRLS shrouds (anti static type).
- 4.5.5 Batteries to be installed in earthquake prone areas should include seismic tests on batteries & stands.
- 4.5.6 Vendor should submit data for hydrogen gas evolution under float and boost conditions.

4.6 Control, Monitoring and Display

4.6.1 The UPS, single or multimodule, shall monitor and control through the use of menu-driven commands. System logic and control programming shall be resident in Application Specific Integrated Circuits and shall be solid state using switches, contacts and relays only to signal status of mechanical devices or to signal user control inputs. Redundant control voltage shall be available for all functional blocks.

4.6.2 A microprocessor shall control the display and memory functions of the monitoring system. All voltage and current parameters shall be monitored using true RMS measurements ($\pm 1\%$ accuracy) displaying all three phases of three phase parameters. Display shall show, but not limited to the following:

Input	Output
<ul style="list-style-type: none">• Voltage (L-L & L – N)• Current• Frequency	<ul style="list-style-type: none">• Voltage (L-L & L – N)• Current• Frequency
<p>Battery</p> <ul style="list-style-type: none">• Voltage• Charging Current• Discharging Current• Time left during Battery operation by pass	<ul style="list-style-type: none">• KVA• KW• % rated KVA

4.6.3 Alarms listed below shall be displayed in text and audio formats.

- Ambient over temperature
- Equipment over temp.
- Over temp. time out
- Input
 - Under Voltage
 - Over Voltage
 - Under frequency
 - Over frequency
 - Input fail
 - Input current imbalanced
 - Rectifier fuse blown
 - Blower failed
 - Reverse power
 - Over load shut down
 - Hardware shut down
 - Inverter fault

- Inverter non-synchronized
- DC over Voltage shutdown
- DC ground fault
- DC capacitor fuse blown
- Battery circuit breakers open
- Batter discharging
- Low battery shut down
- Output
 - Load on by pass
 - Auto transfer to By pass
 - Bypass not available
 - Bypass – wrong phase sequence
 - Control power failure
 - Communication failure

The alarm displays shall not be limited to the above.

- 4.6.4 The system shall provide a connection for a remote terminal in RS232 format through a compatible modem and also a local terminal. All system features and alarms shall be capable of being remotely monitored leading to remote maintenance. In addition the following I/O points shall be provided 6 universal points, 8 potential free contacts.
- 4.6.5 Battery monitoring system
- 4.6.5.1 System shall have the interactive ability to first identify and then provide an isolated equalizing charge current to any individual cell or jar that deviates below a user-specified set point, from the cell average, within the same string or bank.
- 4.6.5.2 The system shall provide estimated backup time remaining during an actual discharge.
- 4.6.5.3 The Battery Monitoring System shall monitor and maintain historical files for:
- a) individual cell or jar voltage
 - b) total bank voltage
 - c) discharge current
 - d) ambient and pilot cell temperature
 - e) relative current response value

- 4.6.5.4 Cell voltage measurements must be made to within plus or minus 5 millivolts over the entire operating and temperature range.
- 4.6.5.6 Documentation, Manuals and installation documentation for the equipment shall be provided which lists block diagrams, schematics parts list and theory of operating for each unique component of the system. Installation drawings and documentation shall be site specific for each string at this facility.
- 4.6.5.7 The system shall be factory tested fully and completely before shipment.
- 4.6.5.8 Site testing: Each measurement shall be tested and to assure that is properly corresponds to the correct cell location and that the measured value corresponds to a separate measurement taken within a four (4) digit laboratory accuracy Digital Voltmeter which has been calibrated to NBS standards within the past six (6) months. Manufacturer shall submit test procedures for approval.
- 4.6.5.9 Support shall be provided as follows:
 - a) At least 2 – 4 hour on site training sessions shall be provided after installation and start up is complete with the operation of the battery monitoring system.
 - b) Factory trained field service engineers shall be available for maintenance and repair of the battery monitoring system within 4 hours of the service call.

5.0 **Testing, Training and Service**

5.1 **Unit Start-up and Testing**

- 5.1.1 Factory testing shall be provided by the manufacturer as follows: Factory acceptance testing shall consist of a complete test of the UPS system and the associated accessories supplied by the manufacturer. A full 100% load, 24 hour burn in load power test including a 50% battery discharge test shall be provided as part of the standard start-up procedure. Overload test for 10 min. at 125% load and 30 sec. at 150% load. The test results shall be documented, signed, and dated for future reference.

5.3 Manufacturer's Field Service

5.3.1 The manufacturer shall provide a fully automated national dispatch center to co-ordinate field service personnel schedules. One toll-free number shall reach a qualified support person 24 hours/day, 7 days/week, 365 days/year. Emergency telephone service response time shall be 20 minutes or less, and on site service response time within 4 hours.

5.4 Replacement Parts Stacking

5.4.1 Parts must be available for guaranteed delivery with 12 hours.

6.0 Warranties

6.1 Provide 3year warranty for full battery replacement (material and labor).

6.2 UPS shall be warranted to be free from defects for a period of 2 years from the date of acceptance of equipment. Warranty and preventive maintenance service shall be performed by factory-trained personnel.