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## 18 UNINTERRUPTIBLE POWER SUPPLY SYSTEMS

### 18.1 GENERAL

#### 18.1.1 Scope

1 This Part specifies the requirements for uninterruptible power supply systems.

2 Related Parts and Sections are as follows:

This Section

Part 2..... FBA

Part 3 ..... Protective Devices

Part 6..... Cables and small wiring

Part 7..... Conduits

Part 8..... Trunking

Part 9..... Cable trays

Part 10..... Accessories and General Power

#### 18.1.2 Description

1 A single UPS System shall be provided for the Main Control Room (MCR) Data Communication system (DCS), and peripheral equipment, essential field instruments and essential equipment subject of Engineer approval.

#### 18.1.3 References

1 The following Standards are referred to in this Part:

ENV 50091-3:.....Uninterruptible Power Systems (UPS) - Part 3: Performance requirements and test methods;( IEC 62040-3 Title Uninterruptible power systems (UPS) - Part 3: Method of specifying the performance and test requirements)

EN 60439 .....Low-voltage switchgear and controlgear assemblies; (IEC 61439 Low-voltage switchgear and controlgear assemblies)

EN 60950 .....Information technology equipment – Safety; (IEC 60950 Information technology equipment – Safety)

Engineering Recommendation G5/4: Planning levels for Harmonic Voltage Distortion and The Connection of Non-Linear Equipment to Transmission Systems and Networks in the UK

IEC 157 .....Low Voltage Switchgear and Control gear

IEC 158 .....Low Voltage Control gear

EN 62040 ..... Uninterruptible power systems (UPS)

#### 18.1.4 Submissions

1 Submit in accordance with Part 1

2 Shop Drawings

(a) submit dimensional drawings of the UPS, including sections and elevations, showing the following:

- (i) sizes and positions of components
- (ii) positions and method of fixing cable and boxes
- (iii) location of terminal boards
- (iv) Internal wiring diagram
- (v) Power and control diagrams
- (vi) External connection drawing
- (vii) Component parts lists
- (viii) Other pertinent data.
- (ix) Spare parts list

3 Project Data

- (a) Submit:
  - (i) full specifications of the enclosure and the components of the equipment with relevant sheets of manufacturer's catalogues
  - (ii) confirmation that the equipment complies with the relevant specifications.
  - (iii) Detailed UPS and battery and rectifier size calculation
  - (iv) Previous approval in similar applications

## 18.2 PRODUCTS

### 18.2.1 System

- 1 The UPS system shall be comprise of single rectifier, battery charger and inverter modules:
  - (a) the UPS system shall be designed in such a way that any spare part, printed circuit board, sub-assembly or component, can be replaced without any adjustment
  - (b) it shall supply clean, uninterrupted power to the critical loads and meet the specifications
  - (c) transformers shall be manufactured using vacuum pressure impregnated insulation.
- 2 The Contractor shall assess the electrical load capacity of the UPS taking into account derating for non-linear loads and worst case ambient temperature conditions.
- 3 The UPS cabinet shall be designed such that all components are removable from the front and cable entry by floor mounted gland plates.
- 4 UPS shall be designed and manufactured "standalone" for automatic operation and as such circuit connections; protection devices and the like shall comply with EN 60950, EN 50091-3 and EN 60439.
- 5 The UPS shall be designed to supply clean, uninterrupted power to the loads.

- 6 The design of UPS shall take account of continuous load capacity, de-rating for non-linear loads and ambient temperature conditions. The UPS shall be sized to supply all instrumentation and control equipment including but not limited to control and computer room hardware, mimic, annunciation, telecommunication systems and emergency lighting etc. where applicable.

7 Main Features

The UPS shall consist of fully controlled rectifier charger, battery bank, inverter, static bypass and manual bypass capable to providing safe and secure power supply for a minimum period of 8 hours. The UPS shall include the following features as minimum:-

- (a) optimal quality of the output voltage
- (b) transient over-voltages and spike protection
- (c) voltage variations and mains failures protection
- (d) frequency variations protection
- (e) true single phase regulation
- (f) low noise
- (g) low THD (Not to exceed BS G5/4 limits)
- (h) PC connectivity for parametering as described under particular requirements.
- (i) serial communication 100100 by employing industry standard modbus, fieldbus, NP etc protocol as described under particular requirements.

**18.2.2 Rectifier/Charger**

- 1 The rectifier/charger shall be of solid-state type with fully controlled 6-pulse thyristor bridge and anti-harmonic chokes. It shall have 10 sec walk-in ramp for input current, adjustable battery current and voltage. It shall recharge a fully discharge battery in 24 hours. A boost charge facility shall be provided. A normally open contact rated at 240 Vac, 2A, close on boost charge, shall be provided for remote monitoring. Input voltage ratings are as follows:

- (a) Mains 1 (input to rectifier/charger)
  - Voltage : 415 volts AC  $\pm$  10%
  - Wiring : 3-phase, 4 wire + Earth.
  - Frequency : 45 to 55 Hz.
- (b) Mains 2 (input to static switch)
  - Voltage : 415 volts AC ( $\pm$  15%)
  - Wiring : 3-phase, 4 wire + Earth.
  - Frequency : 50 Hz
- (c) Synchronisation Range:  $\pm$  0.75 Hz

**18.2.3 Battery**

- 1 Unless otherwise specified in the Project Documentation, the batteries shall be of sealed nickel cadmium maintenance free type and sized for the pre-selected time with the UPS operating at rated load. The battery bank shall be sized to maintain full load for a period of 8 hours
- 2 The inverter shall be of transistorised PWM type, for the specified UPS rated power at 0.8 p.f. Output rating shall be as follows:

Wiring	: 3-phase, 4 wire and earth.
Voltage	: 415/240 volts ( $\pm 1\%$ ), 50 Hz ( $\pm 0.25$ Hz).
Transient Voltage Regulation	: Voltage transients shall not exceed $\pm 5\%$ for a 100 % load step change and the return to steady state value shall be in less than 20 milliseconds.
Harmonic distortion	: Less than 4% THD
Efficiency	: For 100% load 92% & For 50% load 91%
Audible noise	: < 65 dBA @ 1.5m

Output synchronised in amplitude, phase & frequency to mains 2 when mains 2 is within tolerance limits. Phase difference between inverter output and mains 2 held below 3° (electrical) in such condition so that the maximum gap while transfer to UPS from Mains 2 and vice versa occurs shall be less than 167 micro seconds.

3 Overload Capabilities:

- (a) inverter shall sustain 125 % overload for at least 10 minutes and 150 % overloads for 1 minute. After delay, if overload persists, the load shall be transferred to bypass supply without break if Mains 2 voltage is within tolerance limits. The UPS shall check the load and if the load is below overload threshold, inverter shall restart automatically, and load shall be transferred back to inverter. Facility to inhibit automatic re-transfer shall be provided.

4 The automatic retransfer to the inverter shall be blocked if a transfer to the mains was initiated six times within one minute or in case of non-synchronization of the inverter with the mains.

#### 18.2.4 Static Switch

1 The static switch shall have anti-parallel connected thyristor bank for instantaneous load transfer between the inverter and the mains 2 supply.

2 Maintenance manual By Pass:

- (a) Manual bypass switch system of full UPS shall be integrated into the UPS so that load can be transferred to mains supply WITHOUT break for maintenance of UPS. Procedure for transfer to maintenance bypass and back to UPS shall be controlled by the bypass menu of the UPS, thus eliminating possibility of causing disturbance of load by operator who is unaware of correct procedures.

#### 18.2.5 Monitoring and Control

1 Monitors:

- (a) the following status information shall be monitored by indicating lights on the front panel of the UPS:
  - (i) rectifier-charger on
  - (ii) load on inverter
  - (iii) load on Mains 2 bypass
  - (iv) alarm
  - (v) inverter shutdown imminent
  - (vi) boost charge

- (b) an audible alarm shall warn the user of faults or operating problems. The system shall be equipped with an alarm off button. Metering values displayed on an alpha-numeric display.
- (c) The following measurements shall be available:
  - (i) inverter output voltage (L-L)
  - (ii) inverter output frequency
  - (iii) inverter output currents
  - (iv) voltage across battery terminals
  - (v) battery current (charge/discharge)
  - (vi) mains 1 (rectifier/charger) input voltages (L-L)
  - (vii) rectifier/charger input currents.

2 Remote Control And Monitoring:

- (a) Remote transmission shall be provided for all controls, monitors and measurement indication on the UPS unit to the site PLC/SCADA.

**18.2.6 Test Procedures**

- 1 For UPS larger than 75 KW the Contractor shall provide a Works Test Report. The integrated functional test shall be conducted at manufacturer's works to ensure satisfactorily functioning of the equipment.
- 2 The Assembly shall not leave the manufacturer's works until the works test sheets have been duly approved and stamped by the Engineer and written permission is obtained for their dispatch to site.
- 3 The UPS manufacturer shall provide proof of a stringent Quality Assurance Program. In particular the main equipment manufacturing stages sanctioned by appropriate tests such as: incoming components inspection, discrete sub-assembly tests and complete functional checks on the final product. Equipment shall undergo on-load burn-in leaving the factory. Final inspection and calibration operations shall be documented in a report drawn up by the supplier's Quality Inspection department.

**18.2.7 Environment**

- (a) Ambient temperature : 0° C to + 50° C
- (b) Maximum relative humidity : 95 %

**18.2.8 Protective Devices, Controls and Monitors**

- 1 The UPS shall be built on modular basis.
- 2 Main Protections - The UPS shall include the following protections as minimum: -
  - (a) Input over voltage
  - (b) Load short circuit
  - (c) Over temperature
  - (d) Surge protection
  - (e) Noise protection
  - (f) Battery deep discharge protection

- 3 Controls shall be micro processor based and the following main controls shall be possible:
- (a) rectifier/charger on/off
  - (b) inverter on/off
  - (c) forced shutdown
  - (d) forced transfer upon forced shutdown of inverter when the bypass power supply (mains 2) is outside tolerances.
  - (e) self-test

END OF PART