

**OMAN WASTEWATER
SERVICES COMPANY S.A.O.C**



**الشركة العمانية
لخدمات الصرف الصحي ش.م.ع.م**

OMAN WASTEWATER SERVICE COMPANY

ELECTRICAL STANDARD SPECIFICATION

SECTION 11

UNINTERRUPTIBLE POWER SUPPLY (UPS)


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1-0 SCOPE

This specification covers the design, manufacture and testing of A.C. Uninterruptible Power Supply (UPS) to be installed within Oman Wastewater Services Company projects.

Uninterruptible power supplies (UPS) shall be provided for equipment which does not have intrinsic back-up from a loss of power and where loss of power would cause:

- An unacceptable level of corruption of important electronically stored data,
- Would disrupt the process control programmes resulting in an unacceptable loss of control of the process or an unacceptable process outage.

2-0 STANDARDS SPECIFICATIONS

The Uninterruptible Power Supply (UPS) shall conform in design, materials and performance (except where otherwise specified) with all relevant Statutory Regulations and the latest editions (at time of order) of all relevant British and Harmonized European standards and international standards including:

- IEC 76 Power transformers
- IEC 85 Recommendations for the classification of materials for the insulation of electrical machinery and apparatus in relation to their thermal stability in service,
- IEC 269 Low voltage fuses,
- IEC 529 classification of degree of protection provided by enclosures,
- IEC 51 Recommendations for direct acting indicating electrical, Measuring instruments and their accessories.
- IEC 146 Semiconductor converters.

- IEC 408 Low voltage air-break switches, disconnectors, air-break switches disconnectors and fuse combination units.
- Omani Electrical Standards

3-0 SERVICE AND ENVIRONMENTAL CONDITIONS

- 3-1 UPS shall, in all respects, be suitable for operation under service conditions stated on Electrical Standard Specification – Section 01.
- 3-2 The system, in particularly the batteries, shall be located within a room/enclosure which shall be suitably ventilated and cooled. The batteries shall be located within a room/enclosure which does not exceed a 24 hour average temperature of 25°C.

4-0 EQUIPMENT ARRANGEMENT

- 4-1 The UPS system shall be comprise of the following modules:

- § Constant voltage, current limiting single rectifier,
- § Battery charger,
- § Inverter,
- § By pass regulating transformer,
- § Static switch,
- § Maintenance switch,
- § Distribution board,
- § Battery isolation and protection.

- 4-2 It shall supply clean, uninterrupted power to the critical loads and meet the specifications.

- 4-3 Where a UPS is to be installed and the electronic components within the equipment being supplied by the UPS are likely to become damaged by mains borne power disturbances or fluctuations, then the UPS shall be fitted with Galvanic Isolation.
- 4-4 The UPS shall be located and mounted to enable easy maintenance.
- 4-5 For the purpose of testing batteries it is essential that covers and doors providing access to the battery terminals can be opened and/or removed without need to isolate or switch off the UPS. Equally such covers or doors shall be locked (requiring a special tool or key to open) to prevent access to the enclosure and fitted with suitable “Danger Live” labels.
- 4-6 Batteries shall have a design life of 10years.
- 4-7 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.

5-0 CONSTRUCTION REQUIREMENTS

- 5-1 The UPS system shall be housed in an enclosure, heavy duty, reinforced steel, freestanding cabinet which requires access only from the front (hinged front panels). Unless specified otherwise, make provisions for Owner's control and power cables to enter either the top or the bottom of the cabinet.
- 5-2 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.
- 5-3 All materials and components making up the UPS shall be new, of current manufacture, and shall not have been in prior service except as required during factory testing. The UPS shall be constructed of replaceable subassemblies. All active electronic devices shall be solid-state.
- 5-4 The core shall be earthed at one point only with a readily accessible removable connection which may be conveniently opened to check the core insulation.

- 5-5 The UPS shall be forced air cooled by internally mounted fans. The fans shall be redundant in nature to ensure maximum reliability. The fans shall be easily replaceable without the use of special tools.
- 5-6 The bypass transformer and distribution board shall be contained in a separate cabinet adjacent to the UPS cabinet.
- 5-7 The cabinets shall be arranged for front access. A removable undrilled gland plates shall be provided with entry position.
- 5-8 Front opening doors shall be provided with locking facilities. Equipment shall be arranged in a logical manner for ease of operation, inspection and maintenance.
- 5-9 Printed circuit boards shall be of plug-in modular type. The modules shall be coded to prevent cross plugging of dissimilar modules and be located in the sub racks by guide rails to ensure positive connection.
- 5-10 PCB cards fronts shall incorporate light emitting diodes (LEDs) for indication, test sockets, potentiometers setting points and finger grips for easy removal.
- 5-11 The battery shall be installed on a free standing support rack.
- 5-12 Provide suitable lifting devices (e.g., lifting eye bolts) for each unit.

6-0 OPERATING PRINCIPLES

- 6-1 The overall configuration shall comprise of UPS units arranged to supply exclusive loads.
- 6-2 The bypass supply will be fed via a 415/120Vac transformer and provides an alternative power source in the event of an inverter fault.
- 6-3 The output of each UPS and bypass transformer shall be 120V, single phase and neutral, 50Hz with neutral solidly earthed.

6-4 The criteria for load transfer shall be as follows:

6-4.1 Load transfer from the inverter to the bypass shall only possible when:

- The bypass voltage is within $\pm 10\%$ of the rated inverter output voltage, and,
- The bypass frequency is within the tolerances specified in the data sheet, and,
- The inverter output and bypass voltages are synchronized.

6-4.2 Automatic transfer of the load shall be initiated when:

- The inverter output voltage drops below 95% of the nominal output voltage,
- The inverter output voltage exceeds 105% of the nominal output voltage,
- The inverter output current limit is exceeded.

6-4.3 Retransfer of the Load from the bypass to the inverter shall only possible when:

- The inverter output voltage is within $\pm 10\%$ of the nominal output voltage for more than 5 seconds and,
- The inverter output and bypass voltages are synchronized.

7-0 COMPONENTS

7-1 Battery Subsystem:

- 7-1.1 Sealed maintenance-free batteries and sized for the pre-selected time with the UPS operating at rated load shall be provided.
- 7-1.2 The batteries shall have an expected life of ten (10) years.
- 7-1.3 The batteries shall be fully wired and contained within either the UPS cabinet or a separate battery cabinet. Battery run time (based on 100% full load) shall be no less than the specified time. Optional extended battery run times shall be available.
- 7-1.4 The battery shall be arranged to provide ease of access for maintenance purposes. To save space, multiple stacking may be employed.
- 7-1.5 The battery set shall be installed in similar cabinet finish as the UPS unit.

7-2 Inverter:

- 7-2.1 The inverter shall convert power supplied, from the utility, when within specified limits or from the batteries, when within the battery manufactures' specified limits, to AC power. It shall be a pulse width modulated (PWM) type design with out the need of a transformer.
- 7-2.2 The unit shall have a single power PCB for maximum reliability (multiple PCB's decrease reliability).
- 7-2.3 The inverter shall be capable of delivering its rated output within the specified voltage and frequency limits with the battery disconnected.

7-3 Rectifier:

- 7-3.1 The battery voltage and rectifier output voltage shall be in accordance with manufacturer's standard. The rated output current of the rectifier shall supply simultaneously, the inverter rated output power and the battery charge requirements when operating in either float-charge or rapid charge mode.
- 7-3.2 A DC circuit earth-fault monitoring unit shall be provided to automatically initiate the relevant indications and alarms in the event of an earth fault.
- 7-3.3 The rectifier shall restart automatically upon restoration of the power supply following a mains power interruption.
- 7-3.4 During transient input voltage depressions down to 80% of nominal voltage, the rectifier DC output voltage variations shall be controlled to a value that will at least prevent the initiation of battery discharge.
- 7-3.5 Facilities shall be provided for manual and automatic initiation of battery rapid charge operation. Automatic initiation of battery rapid-charge operation shall occur following any period of battery discharge with duration of more than 20 seconds.

7-4 Static Bypass Switch:

- 7-4.1 The unit shall contain a Static Bypass Switch (SBS) as a standard feature. The normal operating mode of the SBS is to connect the Inverter to the critical load with the utility in a standby mode; in case of any converter/rectifier or Inverter failure the SBS will transfer to the Utility without interruption to the critical load.
- 7-4.2 The use of a transformer, to convert the utility, is permitted when the input utility voltage is not the same as the unit's output voltage requirements.

7-5 Maintenance Manual By Pass:

7-5.1 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.

7-5.2 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.

7-6 Charger:

7-6.1 The battery charger shall maintain the batteries at full charge. The standard battery charger shall recharge the battery in 10 times the discharge time maximum.

7-7 Power Connections:

7-7.1 The UPS shall be hard wired input and output.

8-0 PROTECTIVE DEVICES , MONITORING AND CONTROL

8-1 All circuits, AC input, rectifier DC output, battery circuits, inverter AC output and outgoing circuits shall be adequately protected by switches and fuses.

8-2 The UPS unit shall incorporate all the necessary control equipment to fulfill the performance requirements of this specification, and to protect the unit and its components from excess current under all operating conditions. Selectively operating protective devices shall be as required to safeguard the unit from the consequences of internal and external short circuits, overvoltages, load short-circuits, external or internal over-temperature and any main or control circuit malfunctions.

8-3 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 voltage is within tolerance limits.

- 8-4 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.
- 8-5 Facility to inhibit automatic re-transfer shall be provided.
- 8-6 The inverter AC monitoring unit shall activate the “inverter AC output deviation LED’s” and shall initiate the changeover to the mains supply if the inverter AC output is outside its tolerances.
- 8-7 The following status information shall be monitored by indicating lights on the front panel of the UPS:
- Rectifier-charger “on”,
 - Load on inverter,
 - Load on Battery,
 - Load on bypass,
 - Alarm,
 - Inverter shutdown imminent,
 - Boost charge,
 - Inverter/Charger Fault
 - Low Battery Voltage.

An audible alarm shall warn the user of faults or operating problems. The system shall be equipped with an alarm off button.

8-8 The following measurements shall be available:

- Inverter output voltage (L-L),
- Inverter output frequency,
- Inverter output currents,
- Voltage across battery terminals,
- Battery current (charge/discharge),
- Mains (rectifier/charger) input voltages (L-L),
- Rectifier/charger input currents.

8-9 Remote Control And Monitoring:

- Remote transmission shall be possible for all controls, monitors and measurement indication on the UPS unit to the DCS/SCADA.

9-0 FINISH

8.1 The Vendor shall submit his proposed painting specification for review and approval by the buyer.

8.2 The paint specification shall be suitable for the environment in which the UPS is to be located. The finish colour shall be the manufacturer's standard.

8.3 The finish shall be suitable for the service conditions stated in section 3.0.

10-0 SPECIAL TOOLS

A complete set of any special tools required for operation, commissioning and maintenance.

11-0 SPARES

The Vendor shall provide a list of recommended commissioning and operating spares.

12-0 INSPECTION AND TESTING

12-1 Tests shall be carried out by the manufactures at his works in accordance with the relevant standards.

12-2 The UPS manufacturer shall provide proof of a 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.

12-3 Final inspection and calibration operations shall be documented in a report drawn up by the supplier's Quality Inspection department.

13-0 SHIPPING, HANDLING AND STORAGE

13-1 Preparation for shipment shall protect the UPS units and auxiliary devices, against corrosion, high humidity, dampness, breakage or vibration injury during transportation and handling.

13-2 The location of lifting points shall be clearly marked on the containers.

13-3 Each container shall be identified with the contents, purchase order and item number and clearly marked with its weight.

14-0 DRAWINGS AND DATA

14-1 The Vendor shall provide drawings and data in accordance with international standards.

14-2 The specified UPS system shall be supplied with user's manual. Manuals shall include installation drawings and instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step-by-step operating procedures, and routine maintenance guidelines.

14-3 Shop Drawings

Submit dimensional drawings, including sections and elevations, showing the following:

- Sizes and positions of components
- Positions and method of fixing cable and boxes
- Location of terminal boards
- Other pertinent data.

15-0 DEVIATIONS

Deviations from this specification are only acceptable where the vendor has listed in his quotation the requirements he cannot or does not wish to comply with and the purchaser has accepted, in writing.

In the absence of a list of deviations it will be assumed by the purchaser that the vendor complies fully with this specification.