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PORT OF DURBAN

ELECTRICAL ENGINEERING

TECHNICAL SPECIFICATION FOR UNINTERRUPTIBLE POWER SUPPLY (UPS)

1. BACKGROUND

Uninterruptible Power Supply (UPS) units at the Port of Durban are mainly used to provide continuous power to CCTV cameras and data storage servers such as the Security Centre, Ports online, TNPA SAP system, and Engineering data storage servers. The above-mentioned loads are critical to the port and are sensitive to frequency deviations, voltage transients and voltage dips. UPS systems are therefore required to compensate for the variations in the input supply as any irregularities will affect the load.

2. SCOPE OF WORK

The scope of work covers the delivery, supply, installation, and commissioning of new Uninterruptible Power Supply (UPS) units for the Port of Durban. The new UPS units will replace the existing UPS units that have reached their designed life span. Part C4 of the NEC 3 outlines the location of the UPS units that are included in this scope.

3. DETAILED TECHNICAL SPECIFICATION

The UPS system shall consist of rectifier/charger, batteries, inverter, static bypass, manual bypass, user and communications interface, protective devices and accessories that automatically provide continuous supply of electric power to its load within tolerances as set out in this Technical Specification without interruption upon the failure or deterioration of the normal AC supply.

a. Uninterruptible Power Supply systems:

- The UPS system designs shall comply to all applicable SANS standards.
- UPS systems shall be On-line double conversion types
- For office areas, communication rooms and data centre environments, UPSs shall be rated at an IP rating of 20 (IP20). For UPS's exposed to extreme environments (e.g., security gates) the IP rating shall be IP54, and for the UPSs in substations, the UPS shall be IP 31.

Note: If the IP rating recommended is not achievable, a higher achievable shall be supplied.

- To prevent corrosion, printed circuit boards inside UPSs must be tropicalized.
- All active electronic devices in UPS systems shall be in solid state. All semiconductor devices shall be hermetically sealed. All relays shall be dust tight.
- Each UPS shall have its own battery cabinet sized to provide the backup time as outlined in this specification.
- Each UPS shall be equipped with a Simple Network Management Protocol (SNMP) card that will be used to manage, monitor, and control the UPS.
- Larger UPS systems (80 KVA, 40 KVA and 20 KVA) shall consist of a parallel redundant load sharing mode.
- The UPS system shall be constructed in heavy-duty metal enclosures and designed for floor mounting.
- Each UPS shall be supplied together with all interconnecting cables sized accordingly.

- The UPS system shall have regulated and self-protection functions against the following conditions:
 - (i) overvoltage
 - (ii) power line surges
 - (iii) undervoltage and overcurrent introduced by the incoming AC mains supply
 - (iv) overvoltage and voltage surges introduced at the output terminals by paralleled sources, load switching and circuit breaker operation in the distribution system
 - (v) sudden changes in the output load and short circuits at the output terminals
- Ringing transients, voltage spikes and surges shall be suppressed and shall be removed from the output of the UPS system.
- The overall efficiency of the UPS system, output to input, shall achieve the following efficiencies for UPS at 50% rated load:
 - i) $\geq 89\%$ (≥ 10 to < 20 kVA UPS)
 - ii) $\geq 89.5\%$ (≥ 20 to < 40 kVA UPS)
 - iii) $\geq 90.5\%$ (≥ 40 to < 200 kVA UPS)
 - iv) $\geq 92\%$ (≥ 200 kVA UPS)
- A manual/maintenance bypass shall be provided to allow maintenance personnel to manually isolate the UPS system from the load for maintenance purpose and connect the load directly to the incoming AC mains supply.
- A battery circuit breaker shall be provided to allow maintenance personnel to isolate the batteries from the UPS system for maintenance purpose without affecting the normal power supply to the load.
- The UPS system shall be equipped with an emergency shutdown switch. When the emergency switch is activated, the UPS system input, output and battery circuit breakers shall be open, and the UPS system shall be completely isolated from all sources of power. The emergency shutdown switch shall be protected with cover to prevent accidental shutdown.
- The UPS shall be capable of operating in three different operating modes:
 - (i) Normal mode
 - (ii) Discharging mode; and
 - (iii) Bypass mode.

Normal mode:

(a) Under normal operation, the rectifier/charger unit shall convert the incoming AC mains power supply to DC power.

(b) The rectifier/charger unit output shall feed the inverter and charge up the batteries simultaneously. The inverter shall convert the DC power into AC mains power which feeds the load.

Discharging mode:

- a) Upon failure of the incoming AC mains supply or the incoming AC mains supply voltage goes outside the tolerances as set out in the Particular Specification, the inverter and the batteries shall continue to supply power to the load without interruption or disturbance.
- b) Alarm indications shall be provided to indicate the failure of AC mains supply and the operation in the Discharging Mode.
- c) The UPS system shall continuously run in this Discharging Mode:
 - i. for a duration as set out in the Particular Specification; or
 - ii. until the incoming AC mains supply to return to normal at which the UPS system returns to Normal Mode. Alarm indications shall be automatically reset.
- d) "Battery low" alarm indication shall be given if the batteries reaching the cut-off voltage and the batteries are nearly drained to depletion. The UPS system shall automatically transfer to By-pass Mode.

Bypass mode:

The UPS system shall transfer the load to the incoming AC mains supply by-passing the rectifier/charger unit, batteries and inverter without any interruption under the following conditions:

- a) malfunction or failure of any modules of the UPS system
- b) the batteries are drained to near depletion
- c) over-temperature
- d) overloads
- e) load current transients (inrush or fault clearing)

b. Remote Monitoring

The UPS units shall be monitored through SCADA software and each UPS unit shall have an SNMP card that shall be used for connecting the UPS to LAN through an Ethernet port to broadcast information about the UPS status to SCADA. The UPS units shall be monitored in two separate monitoring stations i.e., TNPA Security UPS's and TNPA Engineering UPS's. The following components shall be provided and configured for remote monitoring:

- a) Simple Network Management Protocol (SNMP) card
- b) RJ45 CAT 6 cables to connect the UPS to the existing network switches
- c) Two Monitoring station desktop PCs

The SCADA system shall be configured to record historical events, send mail and text message alerts, and provide remote access to real-time status.

c. AC-to-DC Battery Charger/Rectifier

- The AC-to-DC battery charger/rectifier shall be designed to convert the incoming primary AC power to regulated filtered DC power which shall supply the battery under all mains supply conditions.

- The charger shall provide sufficient current to charge the batteries at the C/10 rate for all input mains conditions up to –15% of nominal input voltage.
- The battery shall be kept in a fully charged state i.e., continuously floating across the charger.
- Battery ripple current shall be no more than 7% of the 3 hour ampere/hour rating of battery.
- The rectifier shall be switched off if any of the rectifier phases should fail.
- A device shall be provided to limit the inrush currents of each charger. When AC power fails and during generator set start, the rectifier shall limit the power drawn by implementing a walk-in for ten seconds.
- Over temperature protection of the rectifier shall be provided.

d. DC-to-AC Inverter

- The DC-to-AC Inverter shall be designed to convert the DC supply from the rectifier or the battery.
- The inverter shall maintain a high conversion efficiency at the rated load.
- The inverter shall be adequately protected against excessive overloads or short circuits that may occur in the load.
- The inverter DC cut-off shall be no less than 1.67 volts/cell.

e. Standby Batteries/ Battery Cabinets

- The batteries shall be of the Lithium-ion maintenance free and sealed type providing a standby time of 60 minutes for UPS lower than 20 KVA and 120 minutes for UPS size greater or equal to 20 KVA.
- The Contractor shall provide battery sizing calculation for the required battery backup time at the rated load.
- Batteries shall be mounted and wired in a cabinet identical in aspect to that of the UPS and shall have a service life of 10 years or more.
- The batteries shall be equipped with safety vent caps to prevent internal cell explosions caused by internal pressure developed during battery discharge or recharge.
- The batteries shall be complete with cell inter-connectors and row inter-connectors. The output terminals shall be robust and adequately dimensioned for the output cable terminations. All terminals shall be covered with silicone grease to prevent corrosion.
- The inter-connectors between cells and rows of cells shall be constructed in a manner giving the lowest volt drop and maximum resistance to corrosion. Inter-cell connectors shall be protected with anti-corrosion plastic or non-metallic covers.

- Battery times are for the full load rating of the specified unit.
- Batteries are to be housed in stainless steel (e.g., 3RC12) cabinets. The battery cabinet shall be protected with electrolyte-resistant paint.
- Expected battery life of the batteries offered must be specified (i.e., 10 years)
- The containers shall be constructed to give maximum cooling to each cell and to afford as little likelihood of creepage as possible.
- Inter-cell connectors shall be protected with anti-corrosion plastic or non-metallic covers.
- A battery circuit breaker shall be provided to allow maintenance personnel to isolate the batteries from the UPS system for maintenance purposes without affecting the normal power supply to the load.

f. Protection

- The UPS shall have surge protection fitted. Tenderers shall state what protection is fitted.
- All protection circuit breakers used shall conform to SABS or SANS 60947-2 latest version or any recognized international standards.
- The AC input shall be protected by a circuit breaker on the following input circuitry:
 - Reserve (static switch) input
 - Rectifier/Charger input
- The battery/rectifier shall be protected by a fuse or circuit breaker from inverter fault currents.
- The inverter shall be protected by electronic current limiting. The UPS system shall be equipped with an emergency shutdown switch. When the emergency switch is activated, the UPS system input, output, and battery circuit breakers shall be open, and the UPS system shall be completely isolated from all sources of power. The emergency shutdown switch shall be protected with a cover to prevent accidental shutdown.

g. Static Switch

- A very high-speed electronic bypass switch [static switch] shall be connected in parallel to the rectifier/inverter between the mains and output busbar.
- The UPS shall have a static switch rated to supply full load continuously.
- The static switch must be capable of supplying 100% for 5 cycles in order to clear any type of load fault.
- If the inverter output becomes unavailable or goes out of tolerance, the static switch must transfer the load to mains without interruption. The static switch should automatically retransfer the load back to the inverter if the voltage returns to within tolerance.
- The automatic transfer to the mains must be inhibited if the mains are not within a specified tolerance of nominal (normally +15%) or if the inverter output and mains are not in phase.

h. Mechanical Bypass

- A manually operated, quick make, quick break, fault break load make isolator rated for the full output load of the system, shall be provided as a bypass circuit from load to mains, enabling maintenance of the rectifier/inverter system and electronic switch.

i. Earthing Arrangement

- All cabinet(s) must be solidly bonded to good earth in accordance with the SANS standards using an adequate section of cable. The earth connection at the cabinet(s) shall be made to the frame earth terminal provided or alternatively to a substantial part of the basic frame rather than to a bolted-on panel.

j. Indications, Controls, and Alarms

The UPS system shall provide a local mimic panel on the equipment cabinet. The mimic shall depict a complete single-line diagram of the UPS system. The unit should be equipped with a Mimic Panel with LED Status indications of:

- Main's power
- Rectifier status
- DC link status
- Inverter status
- Static switch condition
- Reserve supply
- Output switch position
- Battery switch position
- Bypass switch position

The unit shall include a LCD display with the following features:

- True RMS phase voltages, line voltages and currents of mains input, reserve supply and UPS output
- All DC parameters
- Unique customer configurable identifier
- Real time clock
- Active alarm indication
- Comprehensive password protection

- Interactive keypad, allowing UPS control and easy scrolling through menus
- One thousand event log file (only accessible through the serial port)
- Audible alarm
- Full networking features (using SCADA software and a SNMP UPS network card)
- Remote alarm panel (optional)
- Software configurable alarm relays
- Full serial and modem communication capability
- Remote monitoring of UPS service history and alarms through any SCADA software

The unit shall provide at least a visual indication for the following alarms:

- Overload
- Overload shutdown
- Equipment over-temperature
- Battery circuit breaker open
- Battery discharging
- Low battery voltage
- Input power failure
- Inverter output over-voltage / under-voltage
- Static bypass inhibited
- Load on bypass

4. RATED TECHNICAL AND ENVIRONMENTAL SPECIFICATIONS

General:

Rating : 3-80 kVA 0.9 power factor

Efficiency : 92% at nominal load

Audible noise : < 50 dBA (3 -15 kVA) and <55 dBA (20 kVA-80 kVA) measured at 1 metre distance.

Lightning Protection: Designed to withstand standard test impulses of 6kV and 3kA.

Input:

Nominal voltage : 400 V (3-phase input) for 10 kVA and above

: 230 V (single-phase input) for 3- 6 kVA

Voltage variation: +10% -15%

Frequency : 50 Hz \pm 5%

Output:

Voltage : 230 V (3- 6 kVA) and 400 V (10 kVA-80 kVA)

Regulation : $\pm 5\%$

Power factor : 0.9

Battery:

Type : Maintenance free Lithium Ion batteries

Battery charging: Advanced Battery Management

Backup time : 60 minutes

Communication: USB / RS232 + slot for communications interface with LCD display.

Environmental Conditions:

Altitude : 0 to 2000 m without derating

Ambient air temperature: 0- 40 degrees Celsius

Humidity : As high as 95 % (non-condensing)