SPECIFICATION FOR
TYPE TESTED, LOW-VOLTAGE CRITICAL POWER SYSTEM

General

1.1 STANDARDS

All equipment, switchboards and panels shall comply with Standard BS EN 60439-1, DIN VDE 0660 T.500 section 8.3, and all their electrical and operating characteristics shall be expressed in accordance to these standards.

GENERAL OPERATIONAL CONCEPT AND CONDITIONS

1.2.1. Operational concept

System shall be designed to handle various levels of power quality and reliability as a totally integrated build up with remote monitoring capability of the entire system.

System shall be calculated, dimensioned and designed with appropriate tools in order to fully document all relevant parameters of the entire system. Documentation shall include detailed information related to Selectivity, device set-up /parameterization, layout and complete BOM.

System shall have the following incoming and outgoing feeder panels, depending on load requirements:

- **IFM 1** (Incoming Feeder Mains 1)
  Panel shall include all functional elements such as protecting devices and monitoring equipment in order to provide safe operation of all connected panels

- **IFM 2 / BC** (Incoming feeder Mains 2 / Bus Coupler)
  Panel shall include all functional elements such as protecting devices and monitoring & control of equipment in order to provide safe operation of all connected panels. In addition, panel shall include automatic transfer system control between IFM1 and IFM 2.

- **NEDF** (Non-Essential Distribution Feeder)
  This feeder is fed by a single source (utility) via the Incomer Feeder Mains 1

- **EDF** (Essential Distribution Feeder)
  This feeder is fed by two independent incoming feeders, typically via Incomer Feeder Mains 1 and, as alternate source, Incomer Feeder Mains 2, functionally designed as Bus Coupler.
  In case of power failure of primary feeder IFM 1, switch over to IFM2 shall be automatic, provided IFM 2 has a stable power source available.

- **CDF** (Critical Distribution Feeder)
  Power Reliability and Quality shall be further increased by a integrated VFI-UPS module. UPS module shall be mounted in the same cabinet system, connected directly to the main bus bar system that is fed by IFM1 and IFM2/Bus Coupler.
  A battery bank shall be integrated in the same cabinet system, connected via dedicated DC bus bars to the DC-link of the UPS module. No external cabling between incoming feeders, UPS module including battery and CDF shall be allowed.

- **MCDF** (Mission Critical Distribution Feeder)
  Redundant–Parallel UPS modules shall guarantee highest level of power reliability in a N+1 configuration with no single point of failure.

- **TP UPS** (Transition Panel UPS)
  TP shall include all components to allow a safe by-pass of the entire UPS-system in order to connect CDF or MCDF directly to the bus bar system of IFM1

- **CB** (Control Cabinet)
  All RM&D equipment shall be mounted in one integrated panel. RM&D cabling shall by physically separated from power lines (bus bars and power cables) in dedicated RM&D cable trays.

1.2.2. Ambient conditions

The switchboards shall be for indoor installation, in environmental conditions showing a pollution degree 3 according to BS EN 60439-1.
The reference ambient temperature shall be 35ºC.
Relative humidity shall not exceed 50% at the reference ambient temperature.

GENERAL DESCRIPTION OF THE SWITCHBOARDS

1.3.1 Structure

- The panel structure shall be made of steel.
- Partition steel plates, fastened to the structure, shall divide the switchboard into compartments.
- The position of the partition steel plates shall be adjustable to easily adapt the height of the compartments in steps of 25mm.
- Each compartment shall be closed by an individual practicable steel door on the front, and by independent steel covers on the sides and back.
- Fully independent compartments shall be provided for:
    - Incoming section
    - Main Busbar
    - Cabling
    - Switch-gear
    - Metering and protections

.

Extensions of the switchboard, by addition of similar structures, shall be possible both to the right and to the left of the initial structure.

1.3.2 Covers and doors

All accessible parts of the switchboard shall be conveniently earthed by their assembly means, and shall not require any supplementary specific Earthing lead.
When installed, covers and doors shall ensure a minimum IP30 degree of protection according to Standard BS EN 60529.

- **Side- and back-covers**

  Side- and back-covers shall be flush-mounted on the structure by means of spacers and self-tapping screws, which shall ensure the Earthing of the covers.
  For ease of maintenance, the covers shall be interchangeable and re-usable on any compartment of the same height.

- **Doors**

  The doors shall be provided with internal hinges, ensuring the Earthing of the door.
  The minimum opening angle of the door shall be 130 to 180 degrees.
  The doors shall be pre-punched to accommodate at any time:
    - Door locks
    - Meters
    - Plates for auxiliary components
    - Louvers for ventilation

  Doors for switchgear compartments shall be provided with an interlock, avoiding the opening of the door without previously switching-off the voltage supply to the compartment.
  Doors for Busbar, cable and meter compartments shall be equipped with a lock, to avoid unauthorised access to the compartments.

1.3.3 Compartments

The different compartments formed by the partition plates, shall comply with the following conditions:

- **Incoming and Busbar compartments**
    - The incoming and the busbar compartments shall be separated from the other compartments by moulded plastic finger-proof shrouds.
    - The main Busbar compartment shall be located at the rear of the switchboard, in a top or middle position.
    - The Busbar compartment shall contain all phase and Neutral conductors, duly marked L1, L2, L3, and N.

- Protective conductors shall be located in a separate compartment, and shall be duly marked PE or PEN.
- The Busbar shall be made of flat copper bars, of the same cross-section over the whole width of the switchboard, and allow extensions of the switchboard both left and right.
- All fixed connections shall be maintenance-free.
- Separation links to adjacent columns shall be accessible from the front of the switchboard.
- The Busbar shall be supported by insulators, made of flameproof and leakage-proof material
- For rated currents of 630A and above, flat copper bars shall be used, both for the Busbar and for the in-coming and out-going feeders.

- **Cable compartment**
  - The cable compartment shall contain the out-going terminals for main and control circuits.
  - The cable compartment shall be located to the right of the switchboard.
  - The cable compartment shall be separated from the other compartments by metallic shutters providing a degree of protection of minimum IP20 according to Standard BS EN 60529, to avoid the accidental downfall of parts from upper compartments.
  - Out-going feeders shall have a degree of protection of minimum IP20 according to Standard BS EN 60529, to avoid accidental contacts
  - For out-going feeders of 630A and above, copper bars shall be provided as terminals, to allow the connection of several cables in parallel.
  - All connection terminals and cables shall be mounted in such a way as to avoid any traction or compression forces being exerted on them.
  - The bars and cable supports shall be designed to withstand the presumed short-circuit current.
  - Incoming and outgoing cables shall enter the compartment by the top and the bottom, with front and rear access provided to the connections.

- **Switch-gear and metering compartments**
  - Switch-gear and metering compartments shall be equipped with universal fixing plates, with holes in fixed steps allowing for the mounting of the different switch-gear and metering and protection components
  - Suitable incoming devices using breaker or fuse-switch technology with corresponding ratings and breaking capacity shall protect each switchgear compartment out-going feeder.
  - Meters and signal lamps shall be mounted on the hinged door of the compartment, which shall be pre-punched to accommodate standard instruments and signalling lamps and push buttons

1.3.4 Form of internal separation

Switchgear and metering compartments shall be separated from each other by finger-proof partitions.
Busbar and cable compartments shall be separated from the switchgear and metering compartments by finger-proof partitions.
The manufacturer shall indicate the Form of separation of the compartments according to informative Annex D of Standard BS EN 60439, Form 4b being the minimum required.

1.3.5 Protection and finish

Protection against corrosion
- A zinc coating, providing protection against corrosion according to Standard EN 10142, shall protect all steel parts forming the structure.

- All ferrous parts e.g. hinges, mounting parts, shall be protected by an electro-galvanic zinc coating.

Protection shall be verified in accordance with Standard BS EN 50298.
Following tests shall be made:

- "Wet heat", 6 cycle 24hours with 95% relative humidity at 40ºC, according to Standard IEC 68-2-30
- "Salt fork", 2 cycle 24hours at 35ºC, according to Standard IEC 68-2-11

- **Finish**

  - Covers and doors shall be made of 2mm steel sheet to ensure stability
  - All edges shall be bent-over to avoid sharp edges
  - All external doors and covers shall be flush-mounted to the structure.
  - No hinges, fixing screws or bolts shall be visible from the front of the switchboard
  - All external parts shall show a uniform colour, preferably RAL 7035, applied through an epoxy powder painting of minimum 75 thickness.

2. ELECTRICAL CHARACTERISTICS

Switchboards shall be designed according to the following electrical characteristics:

- **Rated operational voltage Ue:** **690V a.c.**
- **Rated insulation voltage Ui:** **1000V**
- **Impulse withstand voltage:** **8kV 1.2/50 s**
- **Rated frequency:** **40-60Hz**
- **Minimum Rated short time withstand current Icw**
  For Busbars phase conductors with:
  - Rated currents up to 1000A: **50kA 1s**
  - Rated current 1250A: **65kA 1s**
  - Rated currents 1600A up to 4000A: **80kA 1s**
- **Minimum Peak withstand current Ipk**
  For Busbar phase conductors with:
  - Rated currents up to 1000A: **105kA$_{pk}$**
  - Rated current 1250A: **143kA$_{pk}$**
  - Rated currents 1600A up to 4000A: **176kA$_{pk}$**

- **Minimum Cross-sections for Neutral conductor:**
  Busbars with phase conductors with rated currents:
  - Up to 1250A: **300mm^2**
  - 1600A & 2000A: **400mm^2**
  - 2500A & 3200A: **800mm^2**
  - 4000A: **1200mm^2**

- **Minimum Cross-sections for PE or PEN conductors:**
  Busbars with phase conductors with rated currents:
  - Up to 1000A **300mm^2**
  - Over 1000A **400mm^2**

TESTING AND CERTIFICATION

Upon delivery, the manufacturer of the switchboard shall carry out tests with the fully equipped switchboard, according to the relevant Standards indicated below.
For each of the tests, the manufacturer, indicating the results of the tests, shall provide a valid certification.

TESTS ACCORDING TO BS EN 60439-1

3.1.1 Type tests made according to clause 8.2

- **Verification of temperature-rise limits** (clause 8.2.1)
  Maximum temperature-rise with fully loaded compartments shall not exceed the values indicated in Table 2 of BS EN 60439-1.

- **Verification of the dielectric properties** (clause 8.2.2)
  Test Voltage for main circuits shall be 3500V a.c. r.m.s.
  Test voltage for auxiliary circuits shall be 1500V a.c. r.m.s
  Test voltage for the Impulse voltage withstand test shall be 8kV 1.2/50 s
  Clearance and creepage distances shall be in accordance with Tables 14 & 16 of Standard BS EN 60439-1.
  There shall be no unintentional disruptive discharge during the tests
  .
- **Verification of short-circuit withstand strength** (clause 8.2.3)
  Test current for **short-circuit withstand current Icw** shall be at least;
  For Busbars phase conductors with:
  - Rated currents up to 1000A: **50kA$_{rms}$ 1s**
  - Rated current 1250A: **65kA$_{rms}$ 1s**
  - Rated currents 1600A up to 4000A: **80kA$_{rms}$ 1s**

  Test current for **impulse withstand current Ipk** for shall be at least,
  For Busbar phase conductors with:
  - Rated currents up to 1000A: **105kA$_{pk}$**
  - Rated current 1250A: **143kA$_{pk}$**
  - Rated currents 1600A up to 4000A: **176kA$_{pk}$**

  During the tests for short-circuit withstand strength, we have verified:
  - That Busbar-compartment doors and covers remained closed during the test,
  - That full arc containment is achieved.

  An accredited laboratory shall provide the certificate for the results of these tests.

- **Verification of the effectiveness of the protective circuit** (clause 8.2.4)
  All parts of the switchgear combinations shall be effectively connected to the protective conductor, and this connection shall show a resistance below 0.1Ohm.
  After the test for the verification of short-circuit withstand strength of the protective circuit, the protective conductor shall not be impaired.
- **Verification of clearance and creepage distances** (clause 8.2.5)
  It shall be verified that clearance and creepage distances are in accordance with Tables 14 & 16 of Standards BS EN 60439-1, considering a pollution degree 3.
  Minimum values for creepage and clearances combinations shall be used when dielectric properties are tested.
  Withdrawable assemblies, if any, shall additionally endure dielectric tests in their “test” and “disconnected” positions.

- **Verification of Mechanical operation** (clause 8.2.6)
  A minimum of 50 mechanical operations shall be made on the mechanical functions of individual components and groups after installation into the assembly. At the same time, the operation of the functions of coupled & interlocking devices and mechanisms shall be checked.
  After the testing is complete the apparatus, interlocks, etc., shall operate properly and practically the same as before the test.

- **Verification of the degree of protection** (clause 8.2.7).
  The degree of protection shall be verified according to BS EN 60529.

- **EMC tests** (clause 8.2.8)
  Only components complying with EMC requirements shall be used within the assembly.
  If exceptionally required, the manufacturer shall provide a CE Declaration of Conformity, no further testing being required.

3.1.9 Routine tests (clause 8.3)

For the fully assembled and installed switchboard, the following routine tests shall be carried out:

- **Checking of Assembly, wiring & electrical operations** (clause 8.3.1)
- **Dielectric test** (clause 8.3.2)
- **Checking of protective measures & electrical circuits** clause 8.3.3)
- **Verification of insulation resistance** (clause 8.3.4)

Before commissioning the switchboard, the manufacturer, or the installer acting on his behalf, shall issue a compliance certificate stating all these routine tests having been made with positive results.

3.2 TESTS ACCORDING TO OTHER STANDARDS

Where required, for specific functions or components built into the switchboard, specific compliance certificates may be required from the manufacturer.
In particular, compliance to the following Standards may be required:

- BS EN 60204-1 Electrical equipment for industrial machines
- BS EN 60364-4-41 Preventive Measures.
- BS EN 60529 Ingress Protection
- BS EN 60664-1 Isolation Co-ordination.
- BS EN 60947-4-1 Motor Starters with Co-ordinated Short Circuit Protection, with voltage ranges & product ratings to VDE 0106 T100 (BGV A2) Type 2 coordinated.

4.INSTRUCTIONS FOR INSTALLATION, OPERATION AND MAINTENANCE

The manufacturer shall specify in his documents or catalogues the conditions for the installation, operation and maintenance of the assembled switchboard and the equipment therein.
These documents may also include the recommended extent and frequency of maintenance, and a list of recommended spares for the switchboard and equipment therein.

UNINTERRUPTIBLE POWER SUPPLY SYSTEM
INTEGRATED IN
LOW VOLTAGE CRITICAL POWER SYSTEM

5. General

5.1 This specification covers the design, supply, delivery, installation, testing and commissioning of a continuous duty, 50 Hz,120KVA- 480KVA 400V, three phase, (four-wire + earth) uninterruptible power supply system complete with maintenance-free sealed battery.
The uninterruptible power supply system, hereafter referred to as the UPS system, shall operate in conjunction with the existing power distribution system.
The UPS system shall be integrated in the same panel system as the surrounding low-voltage equipment.
UPS shall be connected directly to the bus bar system of the distribution system.
No external cabling between UPS, incoming feeders and the distribution feeders for the UPS-protected load shall be required. UPS bus bar system shall be configured for the maximum power of 4 UPS modules. In the event of an emergency it shall be able to supply independently

at least ___ minutes of clean and regulated uninterruptible power for computer equipment and other critical loads.
Only ”True-On-Line” technology, also called **Voltage Frequency Independent** Operation with By-pass (VFI according to **IEC 62040-3**), following the IEC 62040 standard, are accepted.
UPS output shall be directly connected to bus bars feeding the critical load.

5.2 OPTIONAL: A redundant system can be created by connecting **2, 3 or 4** complete units of the same type **in a parallel-redundant configuration with no single point of failure**.
This parallel redundant configuration shall have redundant batteries and a decentralised bypass concept. **UPS** modules shall be **physically separated** in individual panels (**horizontal modularity**).
Cabinet system shall allow protection level up to **Form 4 between UPS units**.
The load is shared amongst the units connected in parallel. Units with a central control module and/or central static bypass are not accepted. Alternatively the units in one parallel system can share one common battery bank.

5.3 The UPS system and all associated equipment and components shall be manufactured in accordance with the **IEC 62040 standards**

5.4 The **UPS manufacturer shall be ISO 9001:2000** certified and shall have a minimum of **25 years experience** in the design, manufacture, and testing of UPS systems.

6. Tender submission requirement

6.1 The tender submission shall be in sufficient details to show compliance to the specification and shall include a full set of descriptive and technical literature on the equipment and system proposed.

6.2 The following drawings and information are to be submitted with the proposal:
Functional description
Dimensions, weight and heat dissipation of units
Layout plans as integrated system.
Installation drawings

7. Environmental conditions

7.1 The UPS system shall be capable of withstanding any combination of the following environment conditions in which it must operate, without mechanical or electrical damage or degradation of operating characteristics:
Ambient temperature :0 to 40 degrees C (not recommended for batteries)
Relative Humidity: Up to 95% (non-condensing)
Interference: The UPS equipment shall be compliant to **IEC 62040-2 Class A**
Audible Noise - Noise generated by the UPS system under any condition of normal operation shall not exceed an allowable sound pressure level of 70 dBA @1 meter according to **EN27779**
Back feed protection – For safety purposes the UPS shall be equipped with a back feed protection contactor in the bypass circuit, complying to **IEC 62040-1.** This back feed protection shall be installed standard inside the UPS panel.

8. System description

8.1 The UPS system shall consist of the following major equipment:
Rectifier
Boost converter
Battery charger
Static inverter
No-break static transfer switch
Maintenance by-pass switch

Battery bank
Main control panel with LCD display

8.2 The UPS system shall be able to operate in any of the following modes:

8.2.1<u>On-line Mode</u> - During on-line operation mode, the UPS system shall be used to provide precise regulated and transient-free power to the computer equipment loads. The mains supply provides power to the input converter. The input converter shall provide regulated DC power to support the inverter and simultaneously supply the battery charger to maintain the battery in a fully charged condition. The inverter shall convert the DC power into regulated AC power for the load.

8.2.2 <u>ECO Mode</u> - When the load does not require highest level of protection, the UPS shall be able to work in an energy saving mode. This mode shall be fully programmable to adapt it to the load and customer needs. When ECO mode is activated the UPS switches automatically to bypass as a function of the actual mains quality. In case of a mains imperfection (out of tolerances) the UPS seamlessly returns to 'On-line mode' without compromising the guarantee of total security for the critical load. This mode will not be activated unless specifically requested by the client on site.

8.2.3 <u>Battery Mode</u> - Upon failure of the mains supply, input power for the inverter shall automatically be supplied from the connected battery. When the mains is restored or the standby generator set supply is ready, input power for the inverter and for recharging the battery shall automatically be supplied from the rectifier.
If the input does not return, the UPS shall automatically shut itself down in an orderly manner when the discharge limit of the battery is reached.

8.2.4 <u>By-pass Mode</u> - Upon the failure of static inverter, the no-break static transfer switch shall be activated automatically to isolate the faulty inverter and at the same time maintain a continuous supply to the system load. The automatic transfer mode shall also operate in the event of system overloading or if irregular or undesirable output for the load is detected. In this case, the system shall automatically return to the original on-line mode operation if the disturbance is cleared.

8.2.5 <u>Manual By-pass Mode</u> - If the UPS system needs to be isolated for service or maintenance, the maintenance by-pass shall transfer the load from inverter to the mains without interruption and vice versa.

9. Electrical characteristics

9.1 <u>General</u>
UPS Output Power Rating- 120 kVA, 4 wire plus earth, power factor 1

9.2 Multiples available.
<u>Input characteristics</u>
a. Input: - Voltage = 320 - 460 Vac (at full load)
b. - Frequency = 45 - 66 Hz
c. - Power Factor <u>≥</u> 0.98 lagging
d. - THD-I < 10% (optional < 5%)
THD-I is to be constant over a load range of 20% - 100%

9.3 <u>Output characteristics</u>
d. Output: - Voltage = 380/400/415 + N
- Frequency= 50/60 Hz, <u>+</u> 0,1% if free running
= <u>+</u> 4% with mains synch. (Adjustable)

e. Output voltage THD- Linear Load = < 1%
- Non linear Load = < 2%

f. Voltage Transients - at 100% load step = +/- 1%

g. Recovery Time = <3 msec.

l. Inverter Overload Capability = 125% for 10 min.
= 150% for 1 min

k. Crest Factor Acceptance > 3:1 (according to IEC62040-3)

10. Input Converter

10.1 General - The input converter shall consist of a rectifier, which converts the utility voltage into an unregulated DC voltage. This unregulated DC voltage is converted in a regulated, controlled DC voltage by a boost converter. The boost converter supplies power to the inverter and to the battery charger. The boost converter also provides a power factor corrected input to the UPS. The input converter shall use IGBT technology.

10.2 Capacity - The UPS shall have sufficient capacity to support a fully loaded inverter and at the same time maintain the battery in a fully charged condition.

11. Battery Charger

11.1. If the battery is fully discharged, with the standard current, the battery charger shall recharge the battery to 90% of its fully charged condition preferably within six to eight (6-8) hours and at the same time supplying full load current to the system. Otherwise the UPS supplier shall specify the charging time required

11.2 Temperature Compensated Charging - The battery charger output voltage shall be automatically adjusted in proportion to the ambient temperature of the battery as per the battery supplier's recommendation to avoid over-charging.

11.3 Current and Voltage Limit - The rectifier/charger output current and voltage shall be limited to the battery supplier's recommendation.

12. Inverter

12.1.General - power transistors of the IGBT type must accomplish the conversion of DC to AC. Failure of any components or power stage shall not interrupt the AC output. Instead it shall disconnect itself from the configuration while transferring the load to the static transfer switch and activate an alarm.

12.2 Output - The inverter output voltage shall be controlled by microprocessor-based software (software generated sine wave)

12.3 Waveform –The waveform shall be fed through a filter circuit and protected by fast fuses. The inverter shall be able to handle short-circuit conditions without any damage.

12.4 Neutral - The neutral of the inverter output shall be electrically isolated from the UPS system chassis.

12.5 Frequency Control - The output frequency of the inverter shall be controlled by an oscillator, which can be operated as a free running unit or in synchronised operation with a separate AC source.

12.6 If the external synchronising source deviates from the pre-set frequency by $\pm$ 4% (adjustable), the oscillator shall automatically revert to free-running, and the microprocessor controlled accuracy shall be $\pm$ 0.1%.

13 Electronic by-pass switch

13.1 The electronic by-pass shall consist of a static SCR-switch, used to provide an uninterruptible transfer of the load to the utility in case of remarkable variation of the output voltage.

13.2 The electronic by-pass switch shall return the load automatically to the UPS when the malfunction or overload is cleared.

13.3 The electronic by-pass switch shall consist of microprocessor-controlled thyristors.

13.4 The electronic by-pass switch shall be able to be activated manually by a switch/push button to test bypass operation. The switching time from inverter to reserve (bypass) and vice-versa shall be of No-Break. If there is no synchronisation this test should be disabled automatically.

The bypass circuit shall have its own power supply that is redundant to the central power supply of the UPS.

14. Maintenance by-pass

14.1 The maintenance by-pass shall be based on a manually operated switch, which allows the electrical isolation of the UPS from the load while still supplying the load with power directly from the utility.

15 Battery / battery test

15.1 A battery shall provide the UPS system with a stored energy source. The battery shall be of a type designed for standby power service. The cells shall be completely sealed maintenance free.

15.2 The ampere-hour rating of the battery shall be sufficient to support the inverter for the protection time of ___minutes with the inverter operating at full rated load at power factor ____.

15.3 Tenderer shall submit full technical data of the battery offered under the tender and shall provide calculation to show the number of cells required and their capabilities which shall match the load requirement and the charging characteristics of the UPS requirement being offered.

15.4 Tenderer shall specify the recommended voltage per cell for float charging and recharging, acceptable electrolyte specific gravity when fully charged at 25 degrees C.

15.6 The design life span of the battery shall not be less than ___ years and only battery with proven field applications of not less than ___ years shall be accepted.

15.7 The battery shall be mounted on/in shelves/cabinet with the following dimensions ___ x ___ x ___ mm.

15.8 The UPS must be provided with an automatic battery test system.

16. Instrumentation

16.1 A backlit 4 x 20 alphanumeric characters Liquid Crystal Display (LCD), controlled by push buttons shall be provided.

16.2 The UPS system main control panel with LCD backlit display shall include the following measurements indications:
Mains voltage and mains frequency, and the current delivered by the mains

Output voltage and output frequency, and the current delivered by the UPS
Battery voltage and DC link voltage
Remaining runtime (during mains failure)
The total operating time of the UPS and inverter

16.3 The UPS system main control panel with LCD back-lit display shall include the following indications or controls:
Start of a battery test
Forced (manual) transfer to bypass
Enable/disable ECO mode

16.4 The UPS system main control panel with LCD back-lit display shall include the following settings:
Setting of the system operating frequency
Setting of the system output voltage
Setting of the installed battery capacity
Bypass enable/disable
Language on display (English/German/French/Spanish/Italian/Finnish)

16.5 On the system alarm panel, a common **audible alarm and indicating LED's** shall be initiated when any of the following conditions are present:
UPS is on battery operation
UPS is on bypass operation
UPS is on manual bypass operation
Output is not synchronized to input
Bypass input is out of limits
High temperature
Overload
Batteries need to be replaced
Batteries have low voltage (battery low)

16.6 The UPS must be able to store up to 255 alarms or events
Tenderer shall provide detailed information for the above-mentioned together with their tender submission.

17. Mechanical Design

17.1 Enclosure - The UPS system shall be housed in standard low-voltage switchboard panels. All serviceable parts including input/output power connections shall be accessible from the front.

17.2 Colour - The UPS cabinet colour shall be RAL 7035 with 75 microns min paint

17.3 Ventilation - Forced air-cooling shall be provided to ensure that all components are operated within specifications with air entry and exit on the front.

17.4 Power connection – Input and output of UPS system shall be directly on the bus bar system. No additional cabling or protection devices shall be required.

17.5 Modular Construction - The UPS system shall be modular in construction for ease of maintenance and to minimise downtime.

17.6 Isolation of UPS - Adequate modules shall allow easy separation of the UPS from power bus bars in order to allow safe execution of maintenance and repair works.

17.7 Protection - The equipment shall meet the requirements of protection class IP

18. Acceptance

18.1 The Tenderer shall submit detailed acceptance procedures and checklist, which shall be designed to verify the full compliance of the installed system with this specification.

18.2 The acceptance test shall be carried out by the contractor's engineer and witnessed by the end-user's Project Engineer.

18.3 _____ copies of the test report and commissioning certificate stating that the system has been installed and commissioned to the requirement of the specification shall be submitted to the end-user on handing over the commissioned system.

19. Documentation

19.1 All documentation shall be written in good, simple and concise English using accepted technical terms, symbols and nomenclatures. For submission, all documentation shall be bounded with hard covers.

19.2 The document shall be updated regularly as the installation progresses. All changes in the installation layout, wiring, cabling and design shall be incorporated in its final edition. _____ Copies of this final edition shall be handed over to end-user upon commissioning of the system.

19.3 The final edition of the hand-over documents shall cover design, installation, commissioning, operation and maintenance aspects of the system.

19.4 One set of basic consumable spare parts shall be supplied under the contract.

20. Maintenance

20.1 The Tenderer shall be responsible for the maintenance of the system after the expiring of the warranty period. In the tender submission, the tenderer shall include a maintenance agreement for the subsequent maintenance of the system for consideration by the end-user.

20.2 The agreement shall include a fixed sum proposed for five years to perform regular testing and up-keeping of the system.

20.3 The Tenderer shall submit a checklist on the activities to be carried out for the system regular maintenance.

20.4 The Tenderer shall provide evidence and undertake that round the clock on-call service is available to attend to system failure.

21 Options for Interfacing and Communications

21.1 Potential Free Contacts must be available on the UPS to indicate at least 6 alarms. The alarm to be indicated should be free programmable from a list of alarms and working condition presents in the UPS software which should contain at least: general alarm; bypass active; battery low; utility failure.

21.2 Input Connections for customer provided signals must be available ”emergency power off” (to shutdown UPS and load in the event of an emergency).

21.3 Connectivity: It shall be possible to connect the UPS to a TCP/IP network using SNMP (simple network management protocol) using the international standard UPS MIB. The SNMP adapter can be a plug-in card, an external SNMP box or a PC with a proxy agent. In addition, UPS shall be able to communicate via Modbus protocol to a monitoring and control system.

21.4 UPS Data Protection Software The UPS shall have available data protection software compatible with Windows/95, Windows/98, Windows/NT, UNIX, Novell, OS/2 and other common operating systems.