# SECTION - B 2.3

# DC POWER SUPPLY SYSTEM

## 2.3.1 PREAMBLE

A. Ensure all equipment and systems are to provide electromagnetic compatibility within the systems and with any other systems installed in the same location.
B. The Contractor shall install systems strictly in line with manufacturers recommendations and shall ensure all works are in line with recommended EMC mitigation measures in IEC 61000-5 (Installation and mitigation guidelines).

## 2.3.2 SUMMARY

A. General: This section of specification defines the technical requirements for DC Supply Unit, associated DRY Batteries and Battery Circuit Breaker as specified in accordance with the requirements of the Contract Documents and codes.
B. Scope of work: Design, Manufacture, Assembly, Inspection, Testing at Manufacturer's Works, Delivery to Site, Installation and Commissioning of the DC Supply Unit, complete as specified in the schedule of requirement meeting the intents of the Tender. This specification shall be used in conjunction with all drawings, Schedule of requirement and BOQ attached.
C. Equipment to be Supplied:

DC Supply Unit consisting of the following:-

- The DC Power Supply unit shall form a parallel redundant system using two sets of Switch Mode Power Supply (SMPS) type charger units
- MF - DRY battery Set. (Optional)
- Battery Circuit Breakers. Bidder shall note that supply of batteries is an option and is to the discretion of the **Lodha Representative**. **Lodha Representative** may source the batteries separately based on the specifications to be furnished by the Bidder. The Bidder shall furnish in his Bid take-off price for the batteries.
- Interconnecting (Copper) power and control cables between vendors supplied equipment.

D. The equipment shall comply with the technical specification and guaranteed technical particulars specified herein. Any deviations to the specification shall be indicated clearly clause by clause.

E. **The Contractor** shall provide 240 Volts, 1 Phase, 50 Hz, supply to each DC Supply Unit, Vendor to provide adequate space clearance inside the panel for proper termination of incoming and outgoing cables considering Aluminium power cable connection. Cable entry shall be from Top. The distance between DC Supply Unit and batteries will be approximately 15Mtrs. Cables between DC Supply Unit & battery, shall be provided by Vendor. Purchaser shall provide the DC Supply input and output cables only. Vendor to clearly mention all the cable sizes in the offer. Vendor shall indicate the operational philosophy in the offer. Also any special features shall be highlighted.
F. Equipment shall be designed manufactured and tested in accordance with IEC or IS codes and standards.

| | |
|---|---|
| IEC 60044 | Instrument transformers |
| IEC 60051 | Direct acting indicating analogue electrical measuring instruments and accessories |
| IEC 60073 | Basic and Safety Principles for Man-Machine Interface, Marking and Identification. |
| IEC 60076 | Power transformers |
| IEC 60146 | Semi-conductor converters |
| IEC 60255 | Electrical relays |
| IEC 60269 | Low-voltage fuses |
| IEC 60417 DB | Graphical symbols for use on equipment |
| IEC 60445 | Basic and safety principles for man-machine interface, marking and identification - identification of equipment terminals and of terminations of certain designated conductors. Including general rules for an alphanumeric system. |

| | |
|---|---|
| BS EN 60529 | Classification of degree of protection provided by enclosures. |
| IEC 60623 | Vented Nickel-Cadmium prismatic rechargeable single cells. |
| IEC 60715 | Dimensions of low-voltage switchgear and control gear. Standardised mounting on rails for mechanical support of electrical devices in switchgear and control gear. |
| IEC 61000 | Electromagnetic Compatibility for Industrial-Process Measurement and Control Equipment |
| IEC 60947 | Low-voltage switchgear and control gear. |
| IEC 60989 | Separating transformers, autotransformers, variable transformers and reactors. |
| IEC 60050 - 161:1990, IEC 60335-2-76 | Limits and Methods of measurement of radio interference characteristics of household electrical appliances, portable tools and similar electrical apparatus. |
| IEC 60050-161:1990, IEC 60155:1994, IEC 60598 | Limits and Methods of measurement of radio interference characteristics of fluorescent lamps and luminaries |
| IEC 61000-4-6:1996, IEC 11801:1995 | Limits and Methods of measurement of radio interference characteristics of Information Technology Equipment. |

## 2.3.3 SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features. Danger/Warning labels shall have white lettering on a red background and shall be in **English, Hindi**. All other labels shall have black lettering on a white background. All labels shall be fixed by screws or rivets.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Wiring Diagrams: Power, signal, and control wiring.
   2. Technical Details: Voltage, Amp,
   3. Documents shall comprise but not limited to the following :

**A : Indicates that the document to be submitted as per the Lodhas approved material submission schedule.**

**B : Indicates that the document to be submitted after successful testing and commissioning of the integrated system before handing over of the system.**

| Sr. No. | Engineering Data | Reqd With Bid | Required after Purchase Order | | | |
|---|---|---|---|---|---|---|
| | | | For approval | | As built | |
| | | | Qty | Schedule Days | Qty | Schedule Days |
| 1 | Outline dimension drawing | yes | 4 | A | 6 | B |
| 2 | Battery sizing and heat dissipation calculations | yes | 4 | A | 6 | B |
| 4 | Sections with part description | yes | 4 | A | 6 | B |
| 4 | Completed Data Sheets | yes | | | | |
| 5 | Bill of Materials for scope of Supply | yes | 4 | A | 6 | B |
| 6 | Installation / Operation / Maintenance Manual | | | | 4 | With dispatch |
| 7 | Priced Spare List for 2 years service | yes | | | | |
| 8 | Terminal point schedule / drawing | | 4 | A | 6 | B |
| 9 | Description of Control Sequences | yes | 4 | A | 6 | B |

| | | | | | | |
|---|---|---|---|---|---|---|
| 10 | Type test certificate for short circuit withstand for panel | | | | | |
| 11 | Inspection Test Reports | | 4 | A | 6 | At the time of inspection |
| 12 | Test Certificates for bought out items (Battery, Meter, Relay, etc.) | | | | 6 | |

C. Manufacturer Seismic Qualification Certification: Submit certification that DC Supply Unit, accessories, and components will withstand seismic forces. " Include the following:
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
      a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
      b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
   2. Dimensioned Outline Drawings of Equipment Unit: Identify centre of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Factory Test Reports: Comply with specified requirements.
E. Qualification Data: For testing agency / power quality specialist.
F. Field quality-control test reports.
G. Electrical Items on Dwg. shall be represented by graphical symbols in accordance with IEC 60617

### 2.3.4 INSPECTION & TESTING AT MANUFACTURER PREMISES

Following Routine Tests shall be witnessed by the Lodha Representative / his authorized representative at the manufacturer's shop:

A. All equipment, including any sub-supplier equipment, shall be subject to inspection and witness of tests at the place of manufacture by the **Lodha Representative**.
B. The **Contractor** shall perform all standard routine performance and functional tests in accordance with the referenced standards on fully assembled unit(s). Tests shall include the following:
   - Full load heat soak run (on one unit of each rating)
   - Functional and load tests including maximum kW heat loss.
   - Voltage, current and ripple measurements
   - Step load application and rejection.
   - Charger current limiting.
   - Input inrush current measurement.
   - Dynamic simulation of load changeover.
   - Measurement of efficiency.
   - Protection co-ordination.
   - Functional alarm and tripping check.
   - Operation of all equipment.
C. Each individual assembly (except the battery) shall receive a 48 hour minimum burn-in test at maximum charge plus full load for each set of SMPS type charger units prior to performing the standard routine tests.
D. The **CONTRACTOR** shall notify the **LODHA REPRESENTATIVE** two weeks prior to when the tests are to be performed. The **LODHA REPRESENTATIVE** or his representative reserves the right to inspect the entire equipment and witness the tests at the factory. The **LODHA REPRESENTATIVE** shall also have the right to carryout intermediate inspection at **CONTRACTOR**'s works during manufacturing stage.
E. All the expenses towards the Inspection or witnessing the testing of equipment by the Lodha **Representative** will be in the **Contractors** scope excluding boarding and lodging of Lodha Representative.
F. Before final inspection by the **LODHA REPRESENTATIVE**, the **CONTRACTOR** shall confirm satisfactory completion of all in-house routine tests and shop inspections.
G. Tests shall be performed under electrical conditions equivalent to those specified for the site, unless alternative conditions have been submitted with the quotation and approved by the **LODHA REPRESENTATIVE**. Test results shall be extrapolated to allow for the specified site environmental conditions.

H. Battery charger(s) tests shall be performed using the batteries to be supplied with the order, or with identical type and number of batteries. Alternative batteries for test purposes shall require approval by the **LODHA REPRESENTATIVE**.
I. The **LODHA REPRESENTATIVE** shall have the right to request any additional tests that are deemed necessary to prove that the system conforms in it's entirety with all referenced specifications.
J. A certified test report shall be submitted to the **LODHA REPRESENTATIVE**.
K. The purchaser has the right to have the tests carried out at his own cost by an independent agency whenever there is dispute regarding the quality of supply.
L. The results of all tests carried out shall be tabulated and signed jointly by manufacture and **Lodha Representative**. In case the test results are not satisfactory and in accordance of contract specification and there are defects in the materials the same shall be attended and notified to **Lodha Representative**. The equipment shall be dispatched to site of work only after receipt of acceptance of materials and clearance from **Lodha Representative**.

## 2.3.5 MANUFACTURERS

A. Approved Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, those listed in Section G
B. Electronic Equipment: Solid-state devices using hermetically sealed, semiconductor elements. Devices include rectifier-charger, system controls.

## 2.3.6 SYSTEM PARTICULARS

- Rated system voltage : 240 V
- Input voltage : 240V, 1 phase, 4 wire
- Rated Frequency : 50 Hz

## 2.3.7 OPERATIONAL REQUIREMENT

A. The DC Power Supply unit shall form a parallel redundant system using two sets of shelf type rack mounted Switch Mode Power Supply (SMPS) type charger units, each charger unit having its own DRY type Battery Set rated to supply 65% of the load in order to maintain a continuous supply. Each charger unit shall be rated to supply 100% of the load plus the charging current required to simultaneously charge the two battery sets (@ ≈10% of load current as charging current for each battery set), be modular in nature and equipped with N+1 modules as a contingency to cater for a module failure. The modes of operation shall be as listed below and in accordance with the relevant single line diagram.
B. Normal Mode: Under normal conditions both SMPS type charger units shall operate in parallel sharing the total DC load, and each in addition supplying its battery set charging current. Both battery sets charging currents shall be continuously monitored. One of the SMPS type charger units shall derive power from the primary (normal) AC source and the other SMPS type charger unit shall derive power from the emergency AC source.
In the event of total failure of an SMPS type charger unit or loss of primary or emergency AC source an alarm shall be initiated and the remaining SMPS type charger unit shall automatically take over the duty of supplying the total DC load and its battery set charging current. When the lost AC source is restored or the SMPS type charger unit fault is cleared, and after a time delay requested by the **LODHA REPRESENTATIVE**, the restored SMPS type charger unit shall automatically resume its normal duty mode.
C. Emergency Mode: Upon the loss of both SMPS type charger units or both primary and emergency AC sources the total DC load shall be supplied from the two battery sets.
D. Recharge Mode: Upon restoration of both primary and emergency AC sources the restored SMPS type charger units shall automatically resume normal duty mode as described in the first sentence of Section 2.4 (B)
Upon restoration of the primary AC source to its SMPS type charger unit only, the SMPS type charger unit shall supply the total DC load and charge its battery set at a rate relative to the depth of battery discharge (typically between 2.4V per cell on boost charge to 2.35V per cell on float charge for DRY batteries).
Upon restoration of the emergency AC source to its SMPS type charger unit only, the SMPS type charger unit shall supply the total DC load and charge its battery set as described above.

## 2.3.8 CONSTRUCTION

A. The Switch Mode Power Supply (SMPS) type charger units shall be entirely built and tested in the works of the **CONTRACTOR** where regular assembly of similar systems takes place.
B. The system shall include all components shown on the data sheet(s) and/or Single Line Diagram(s) attached to the material requisition, and all other circuit protective devices, regulators, filters, suppressors, instrumentation, and related components required to ensure the integrity and reliability of the system. Separate cubicle(s) shall be provided for each set of SMPS type charger units.
C. The equipment shall be metal enclosed for indoor service, vermin proof, free standing, dead front, with hinged doors for front access only. Minimum metal thickness shall be 2mm. Enclosure shall accommodate top/bottom cable entry. The interior shall be designed to allow all normal maintenance to be performed through the front hinged doors to components. The degree of protection (type of enclosure) shall be as stated on the data sheet(s). All cabinets shall be provided with suitable lifting lugs. Self tapping screws shall not be used in the construction of the equipment.
D. Cooling shall normally be by natural convection. Where air circulation fan(s) are used to assist natural convection, redundant fans with filtered input air shall be provided. Filters shall be easily removable for cleaning or replacement. The charger units shall be capable of continuously delivering their rated output with any one forced air ventilation fan out of service. Under this condition, the maximum continuous temperature of components shall not be exceeded.
E. Un-drilled removable gland plate(s) shall be provided and adequately sized for all external cables. The plates shall be located to provide ease of access for terminating the size and type of cables specified.
F. Busbars shall be tinned copper and covered with insulation. Power supply terminals and terminals powered from outside sources shall be shrouded (guarded).
G. Internal cubicle wiring shall be fire resistant low smoke (FRLS) cables insulated stranded copper conductor (except where manufacturers standard ribbon wiring system is accepted by the **LODHA REPRESENTATIVE**). All wiring shall be adequately designed to meet the load and short circuit currents.
H. Wiring shall be run in wireways with ample spare capacity. Each wire end shall have plastic sleeve type permanently embossed markers to match wiring diagrams and terminal numbers. For control wiring, pre-insulated crimped lugs with terminals shall be used. For power wiring crimped lugs with PVC shrouds shall be used. Screw less, clamp type terminals shall be used for control terminals. FRLS wires with suitable connections shall be used for interconnections for Printed Circuit Boards (PCBs).
I. Flexible cable shall be used for connections to door mounted equipment. Wiring shall be wrapped in flexible PVC conduit and be firmly clamped at both ends to prevent movement at terminations.
J. Power and control cables shall be arranged separately. Wiring terminations at different voltages and of different signal levels shall be segregated and clearly marked.
K. Terminal blocks shall be supplied and clearly marked for wiring that will be installed by the **CONTRACTOR**. Wiring for external connection shall be terminated to one side of terminal blocks and no more than two wires per terminal shall be permitted.
L. All terminal blocks shall have 10% spare terminals (minimum 4). The minimum terminal size shall be 2.5 sq mm. Consideration and provision shall be taken by the **CONTRACTOR** on terminating facilities and terminals for the use of external cables with aluminium conductors.
M. An aluminium earth bar, sized according to equipment rating, shall run through the equipment full length, with all non-current carrying metal parts and cable gland plates connected to it, and shall have an external brass connecting stud for terminating the plant earth. Stud size shall not be less than 10 mm.
N. All doors shall be bonded to the main structure by means of flexible copper connection arranged so that it cannot be trapped as the door is opened or closed.
O. For redundant systems, all components of one system shall be mechanically and electrically separated from other parallel systems. (In separate isolatable enclosures.)
P. Suitable rated anti-condensation heaters shall be provided to prevent the formation of harmful condensation inside the enclosure. The heater shall be supplied complete with thermostat and ON/OFF switch.
Q. All insulation materials shall be non-hygroscopic.
R. The equipment shall allow for the removal of components without special tools. The design shall be such as to facilitate rapid repair/replacement, by utilising removable (hot swap) SMPS modules.

## 2.3.9 DESIGN AND PERFORMANCE

A. All components shall be rated for simultaneously charging the two battery sets plus full load requirements at continuous operation for the specified life of the system in the specified design conditions. All components shall be capable of withstanding the thermal and dynamic stresses resulting from internal and external short-circuits and circuit switching operations, etc. Damage arising from component failure should be confined to the component concerned.
B. Main circuit switches (mechanical) shall comply with IEC 60947-4 and be of the manually operated air-break type and rated for continuous duty. Moulded case circuit breakers shall be category P-2, in accordance with IEC 60947-2.
C. Contactors shall be compliant with IEC60947-4-1 and rated for continuous operation for AC or DC application as appropriate to the service. The utilisation category for DC contactors shall not be less than DC-1 and for AC contactors not less than AC-4.
D. The **CONTRACTOR** shall confirm that no significant radio frequency interference will be generated by the SMPS type charger system. The production of radio frequency interference voltages shall not exceed the values of suppression grade 'N', as defined in IEC 60050-161:1990, IEC 60155:1994, IEC 60598 IEC 60084:1997, IEC 61000-4-6:1996, IEC 11801:1995, or grade 'G', as defined in VDE 0875, for thyristor controlled type rectifiers; and suppression grade 'B', as defined in IEC 60084:1997, IEC 61000-4-6:1996, IEC 11801:1995, for SMPS type chargers.
E. The performance of the DC Power Supply units shall not be affected, or in any way degraded, by the use of equipment (e.g. portable radio transmitters/receivers) operating in the frequency range 27-170 MHz, 460 MHz or 800 MHz when the severity of the electromagnetic radiation environment corresponds to Class 2, in accordance with IEC 61000.
F. Electrical protection shall be designed by the equipment **CONTRACTOR** for all major components to give discrimination under design inrush and all fault conditions. Current limiting over the operating voltage range shall be incorporated on the SMPS type charger units, adjustable up to 120% of the full rated current and factory set at 100%.
G. The SMPS type charger unit modules and controllers shall be protected against damage from on load reversed battery polarity or reverse overvoltage from parallel connected modules by external blocking diodes.
H. Protection shall be provided against supply system switching transients and short circuits.
I. The **CONTRACTOR** shall submit, as part of his quotation, the estimated maximum heat loss in kW from the equipment. The heat loss shall be confirmed after completion of detailed design.

## 2.3.10 SMPS TYPE CHARGER

A. Charger unit shall comprise Switch Mode Power Supply (SMPS) modules to the required number plus one (n + 1), for a requirement of up to ten modules, or the required number plus two (n + 2), for a requirement in excess of ten modules, to supply the total DC load current and simultaneously charge the two battery sets. Unused module racks/shelves shall be pre-wired for future expansion and fitted with blanking plates.
B. In the event of both normal and emergency supplies to the DC Power Supply unit failing and uninterrupted changeover to the batteries takes place then if a supply returns before system shutdown due to low battery voltage the DC Power Supply unit shall resume powering the DC load, however if system shutdown has occurred and then a supply returns the DC Power Supply unit shall perform a 'self-test' and automatically restart and resume powering the DC load.
C. All SMPS modules shall be of the fully controllable type. All SMPS modules shall incorporate a 'soft-start' feature to gradually accept load on initial energising, and shall restart automatically upon restoration of the mains power supply following a mains supply interruption.
D. The charger unit shall be static type composed of SMPS modules and suitable for use with either MF - DRY or NiCad type batteries.
E. The DC output voltage during charging shall be stabilised within $\pm$ 1% of the set bus voltage for an AC input voltage variation of $\pm$ 10%, frequency variation of $\pm$ 4% and DC load variation of 0 to 100%.
F. Charger unit shall be capable of withstanding lightning surges and high energy low frequency transients in accordance with IEC61644-1.
G. The output voltage at the distribution board shall remain within the specified tolerance during battery charge operation.
H. The design of the charger unit shall be such that replacement of an SMPS module can easily be carried out and shall be hot swappable.
I. Each SMPS module shall be provided with an input circuit breaker, surge suppression shall be provided to protect against supply side faults and switching transients, and the design shall incorporate an input isolation transformer.

J. The charger unit output AC ripple shall not exceed 5% rms. total harmonic distortion, for voltages +10% to -20% of the steady state values for external DC load current of 0 to 100% of the rated value; alternatively the charger unit high frequency output noise shall be limited to 50mV rms and the peak to peak ripple, including switching spikes, shall be within 250mV over a 10Hz to 20MHz frequency range. It shall be compatible with the battery requirements in every respect.
K. Temperature compensation of the battery charging voltage shall be provided if DRY type is utilised, and a temperature sensing probe shall be in the scope of supply of the charger unit manufacturer.
L. On failure of one unit, the total DC load shall be supplied by the healthy unit along with its battery charging current. A blocking diode shall be provided in the output of each unit.
M. Each DC Power Supply unit shall be provided with a controller module/unit to supervise, control and monitor all SMPS modules connected as charger units, which shall be of the constant power/current type. The controller shall have a minimum of 4 No. volt-free relay contacts for alarm outputs and shall be capable of output voltage and current adjustment, high ambient temperature voltage adjustment derating and shutdown if required, as well as setting and monitoring range limit alarm and protection values for overvoltage, undervoltage, etc.
N. DC Power Supply unit Total Harmonic Distortion (THD) shall be less than 4% for voltage and current at 25%, 50%, 75% and 100% of rated load.
O. During any step changes of the DC load between 10% and 90% of the load over a 50 microsecond period the DC Power Supply unit output voltage shall remain within ±5% of the nominal and return to normal within 100 microseconds.
P. The SMPS modules that make up the charger unit shall operate in parallel and share the rated load after a settling time to within ±5% of the rated current of the system.
Q. The **CONTRACTOR** shall confirm the maximum in-rush current which can be supplied by the charger unit.
R. A Class 'C' Metal oxide varistor/spark gap type surge suppressor, or equivalent, shall be provided at AC incomer of charger unit. Nominal voltage, fault current, operating voltage, surge characteristics (8/20 microseconds), shall be confirmed.

## 2.3.11 BATTERY

A. Batteries shall be supplied separately to the DC Power Supply units unless otherwise specified on the data sheet(s). Battery type shall be maintenance free (MF - DRY) type with continuous operational life of 12 years if maintained at an ambient temperature of $25^0$C in float mode service, unless specified otherwise on the data sheet(s). The time for the battery to recharge to its full capacity for the rated duty from a complete discharge shall be stated on the data sheets(s).
B. Battery shall meet the design, performance, and test requirements of IEC 60896-2 and are defined as follows:
C. Cell design shall accommodate the total positive plate growth during the design life of the cell. The plate growth shall not cause cracking, deformation, or failure during the lifetime of the cell under normal operating conditions.
D. Cell containers and covers shall be made of a high impact, flame-retardant plastic having a minimum oxygen index of 28%, and shall meet the criteria needed to be rated V-0 when tested in accordance with Underwriters Laboratories Standard UL 94, or FV0 when tested in accordance with IEC 60707.
E. Cell containers and covers shall be designed to minimize flexing of the surface under internal operating pressures. The cover shall be permanently joined to the container to form a leak-proof seal. The complete assembly shall be able to withstand an internal pressure equal to 5 times the normal operating pressure without fracture for 5 hours at 25°C. The complete unit, including the post-to-cover seal, shall remain gas-tight and electrolyte-tight during the design life of the battery.
F. Battery shall have all live surfaces shrouded with transparent full-length insulating cover plates to prevent accidental contact with live cell terminals.
G. Battery module assemblies/battery racks for large batteries shall be constructed of welded or bolted structural steel frames with bolted steel runners and braces, and with metallic stands having earthing terminals and adjustable insulated feet for floor levelling.
H. Racks shall be designed to allow air circulation between individual cells to maintain uniform cooling of each cell and allow easy installation or removal of individual cells from any module without disturbing the rack assembly.
I. Vertically stacked height of batteries shall not exceed 1700 mm above floor level.
J. All metallic components of battery racks, excluding hardware and grounding connectors, shall be painted with two coats of corrosion resistant paint or coated with an acid resistant baked powder epoxy. **CONTRACTOR** shall supply sufficient quantity of field-applied coating for touching up scratches.
K. Each battery set shall be sized to supply 65% of the full rated load in accordance with the DC Load Profile specified on the data sheet(s). The nominal ampere-hour capacity of the battery supplied for

each set of SMPS type charger units shall be determined by the DC Power Supply unit vendor and include for all necessary allowances required to compensate for ageing effects that result in the progressive loss of capacity.

L. Smaller size batteries may be installed inside separate cubicles adjacent to the SMPS type charger units cubicle(s). Drip trays shall be provided to prevent damage due to spillage of electrolyte from vented cells. Cubicles housing batteries shall be freely ventilated.
M. Interconnecting cable between each battery set and set of SMPS type charger units shall be designed and supplied by the **CONTRACTOR**.
N. Each battery shall comprise of a group of cells connected in series to give specified nominal voltage. Each cell shall identify the polarity, electrolyte level, manufacturer, type, ampere-hour capacity, hours basis and date of manufacture, all appearing in a plain and durable manner. Wet cells shall have transparent thermoplastic containers to permit easy checking of electrolyte levels and explosion resistant vent caps shall be provided.
O. The method of earthing shall be as specified on the data sheet(s).
P. The battery shall be furnished complete with insulated inter-cell, inter-row and inter-tier connections and hardware as required.
Q. Means of disconnecting the battery connection to each set of SMPS type charger units shall be provided at the charger cubicle.
R. To disconnect the battery at source a circuit breaker rated for full battery capacity shall be provided by the **CONTRACTOR** for installation outside of the battery room. The device shall be mounted in an industrial type enclosure suitable for locating indoors within an adjacent control room unless specified otherwise on the data sheet(s). The circuit breaker shall be provided with shunt trip protection and be suitable for padlocking in the 'OFF' position.

### 2.3.11 DISTRIBUTION BOARD

A. Where specified, a separate free standing distribution board as specified in the SOQ.
B. All switching shall include both poles.
C. For unearthed systems both poles shall be individually fused or MCB protected.
D. For unearthed systems the DC Distribution board shall be provided with volt meters for displaying positive to ground and negative to ground voltage.
E. The DC Distribution board shall be provided with a mimic diagram showing status of incoming switches.

### 2.3.12 INSTRUMENTS AND ALARMS

A. All controls, indication, meters and alarm facials shall be flush mounted on the front panel, and shall demonstrate in a comprehensive manner the status of all major system components continuously.
B. Metering shall be provided as specified on the data sheet(s).
C. Indication devices shall be provided as specified on the data sheet(s).
D. Alarm devices shall be provided as specified on the data sheets(s).
E. Each alarm specified shall be supplied with local indication (annunciator or individual milky diffused type LED) and also alarm contact(s) of Form C (NO-NC) for connection to a remote location.
F. Provision shall also be made for a remote common alarm (Form C (NO-NC) contact).

### 2.3.13 NOISE REQUIREMENTS

The noise level produced by the system shall be no greater than 70dB.

## 2.3.14 Execution

## 2.3.14.1 INSTALLATION

A. Install freestanding equipment on concrete bases.
B. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the DC Supply Unit.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

## 2.3.14.2 EXAMINATION

A. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions, Lodha equipment layout and IS/IE Standards.
B. Connections: Interconnect system components. Make connections to supply and load a circuit according to manufacturer's wiring diagrams unless otherwise indicated.

### 2.3.14.4 FIELD QUALITY CONTROL

A. Testing Agency: A qualified testing agency to perform tests and inspections.
B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
C. Perform tests and inspections.
   - ❖ Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
D. Tests and Inspections:
   1. Comply with manufacturer's written instructions.
   2. Inspect interiors of enclosures, including the following:
      - ❖ Integrity of mechanical and electrical connections.
      - ❖ Component type and labelling verification.
      - ❖ Ratings of installed components.
   3. Inspect batteries and chargers according to requirements in IS & Specifications.
   4. Load the system using a variable-load bank to simulate kilovolt amperes, kilowatts, and power factor of loads for unit's rating. Use instruments calibrated within the previous [**six months**] according to NIST standards.
      a. Simulate malfunctions to verify protective device operation.
      b. Test duration of supply on emergency, low-battery voltage shutdown, and transfers and restoration due to normal source failure.
      c. Test output voltage under specified transient-load conditions.

### 2.3.14.5 DEMONSTRATION

A. General: Manufacturer's factory-authorized service representative to train Owner's personnel in the operation of the DC Supply Unit.
B. Equipment: Check operation of each unit with Owner's personnel present and before Substantial Completion. Determine that operational systems and devices are functioning properly.
C. Instruction: Instruct Owner's personnel in proper use, maintenance, adjustment, and repair of each system.

### 2.3.14.6 FORMATS

**(A) TECHNICAL PARTICULARS AND GUARANTEES FOR DC SWITCHBOARD PANELS DC BATTERIES AND BATTERY CHARGERS**

| S1. No. | Description | | Technical Guarantees |
|---|---|---|---|
| | **I - DC DISTRIBUTION PANEL** | | |
| 1 | Applicable Standard | | |
| 2 | Manufacturer & Country of origin | | |
| 3 | Manufacturer's Type No. | | |
| 4 | Overall Dimensions Weight of Panels: | | |
| | i) Height | mm | |
| | ii) Width | mm | |
| | iii) Depth | mm | |
| | iv) Weight | Kg. | |
| 5 | Painting | | |
| | i) Applicable Standards | | |
| | ii) No. of coats. | | |
| | iii) Colour | | |
| 6 | Bus bar | | |
| | i) Material | | |
| | ii) Dimension | mm x mm | |
| 7 | Incoming connections | | |
| | i) Size and type of connections | | |
| | ii) Type of Protection | | |
| | iii) Rating | A | |
| | iv) No. of connections | | |
| 8 | Out going connections | | |
| | i) No. of outgoing connections | | |
| | ii) Type of Protections | | |
| | iii) Single line diagram giving details enclosed. | Yes/No | |

**A-CONTINUED**

**TECHNICAL PARTICULARS AND GUARANTEES FOR DC SWITCHBOARD PANELS DC BATTERIES AND BATTERY CHARGERS**

| S1. No. | Description | | Technical Guarantees |
|---|---|---|---|
| 9 | Moulded case circuit breaker (one incomer, one with battery & one with battery charger) | | |
| | i) Manufacturer & country | | |
| | ii) Rating | A | |
| | iii) Short circuit breaking current | KA | |
| | iv) Tripping mechanism | | |
| | v ) Earth leakage current rating | mA | |
| | vi) Guaranteed No. of make & break | No | |
| 10 | Miniature circuit breaker | | |
| | i) Manufacturer and country | | |
| | ii) Rating | A | |
| | iii) Short circuit breaking current | KA | |
| | iv) Tripping mechanism | | |
| | v) Guaranteed No. of make & break | Nos | |
| 11 | Ammeter | | |
| | i) Manufacturer & country | | |
| | ii) Range | A | |
| | iii) Accuracy class | | |
| 12 | Earth Fault Detecting Relay | | |
| | i) Manufacturer | | |
| | ii) Type No. | | |
| | iii) Range | | |
| | iv) No. of alarm contacts | | |
| 13 | Low voltage relay | | |
| | i) Manufacturer | | |
| | ii) Type | | |
| | iii) Range of voltage adjustment | V | |
| 14 | Voltmeter | | |
| | i) Manufacturer | | |

**A-CONTINUED**

**TECHNICAL PARTICULARS AND GUARANTEES FOR DC SWITCHBOARD PANELS**
**DC BATTERIES AND BATTERY CHARGERS**

| S1. No. | Description | | Technical Guarantees |
|---|---|---|---|
| | **II BATTERY CHARGER:** | | |
| 15 | Manufacturer and country of origin | | |
| 16 | Applicable standard | | |
| 17 | Type No. | | |
| 18 | AC Voltage<br>a) Voltage: | | |
| | i) Nominal | V | |
| | ii) Admissible range (±) | V | |
| | b) Frequency | | |
| | i) Nominal | Hz | |
| | ii) admissible range (±) | Hz | |
| | c) Apparent Power | KVA | |
| 19 | DC output | | |
| | a) Float charge | | |
| | i) Nominal voltage | V | |
| | ii) Limits of variations (±) | % | |
| | iii) Nominal current | A | |
| | b) Boost charge | | |
| | i) Nominal voltage | V | |
| | ii) Limits of variations (±) | % | |
| | iii) Nominal current | A | |
| 20 | Continuous Operation | | |
| | i) Nominal voltage | V | |
| | ii) Limits of variations (±) | % | |
| | iii) Nominal current | A | |
| | iv) Peak current | A | |

**A-CONTINUED**

**TECHNICAL PARTICULARS AND GUARANTEES FOR DC SWITCHBOARD PANELS DC BATTERIES AND BATTERY CHARGERS**

| S1. No. | Description | | Technical Guarantees |
|---|---|---|---|
| 21 | Voltage Ripple | % | |
| 22 | Overall dimensions (LxWxD) | mm | |
| 23 | Total weight | Kg. | |
| 24 | Number & rating of distribution circuits | | |
| | **III - BATTERY** | | |
| 1 | Manufacturer and country of origin | | |
| 2 | Applicable standard | | |
| 3 | Container type | | |
| 4 | Type of cells | | |
| 5 | Electrolyte | | |
| 6 | Type & size of Terminals | | |
| 7 | Nominal Voltage | V | |
| 8 | Capacity at 5 hour rate | Ah | |
| 9 | Number of cells | No | |
| 10 | Voltage per cell | V | |
| 11 | Normal charging rate | A | |
| 12 | Maximum charging rate | A | |
| 13 | Ampere-hour efficiency at 5 hour rate | % | |
| 14 | Ampere-hour efficiency at 1 hour rate | % | |
| 15 | Dimensions of cell | mm | |

**A-CONTINUED**

**TECHNICAL PARTICULARS AND GUARANTEES FOR DC SWITCHBOARD PANELS**
**DC BATTERIES AND BATTERY CHARGERS**

| S1. No. | Description | | Technical Guarantees |
|---|---|---|---|
| 16 | Overall Dimensions | mm | |
| 17 | Weight of cell complete with electrolyte | Kg | |
| 18 | Total weight | Kg | |
| 19 | Internal resistance per cell when fully charged | Ohm | |
| 20 | Battery voltage at end of the duty | V(min) | |
| 21 | Mounting<br>i) Type of arrangement<br>ii) Approximate dimensions | <br>mm x mm<br>mm x mm | |
| 22 | Maintenance tools included | Yes/No | |
| 23 | Floating voltage | DC V | |
| 24 | Maximum charging voltage | DC V | |

Signature: _____

Designation: _____

Name of Tenderer: _____

Date: _____

## (B) SAT FORMAT FOR DC SYSTEM

### 1. Pre Commissioning Checks

### 1.1 CHARGER:

| Sr. No. | Description | Result |
|---|---|---|
| 1.1 | Check for Shipping damage | |
| 1.2 | Check for Proper Installation and fixing | |
| 1.3 | Check for Earth connection | |
| 1.4 | Check equipment interior is free from foreign objects & Packing pieces | |
| 1.5 | Check any loose wires inside the equipment and cable dressing | |
| 1.6 | Check labelling of all devices/equipments | |
| 1.7 | Check rating of Voltmeters & Ammeters | |
| 1.8 | Check for proper termination of external Input/output cables | |
| 1.9 | Check all the connections are proper | |
| 1.10 | Check Polarity of termination | |
| 1.11 | Check Input and Output fuse/breakers | |
| 1.12 | Check cleanliness inside the Charger | |
| 1.13 | Check for any corrosion in Charger & Batteries | |

### 1.2 BATTERY:

| Sr. No. | Description | Result |
|---|---|---|
| 2.1 | Check type & Number of Cells/Blocks as per Order | |
| 2.2 | Check for damage to Cell & Leakage | |
| 2.3 | Check alignment of Cells/Blocks on Stand/Rack | |
| 2.4 | Check Cell/Blocks installed in right sequence and Polarity | |
| 2.5 | Check Cell/Block clean and Connection tightened | |
| 2.6 | Check connection between Charger & Battery with correct Polarity | |

| **1** | **Carry out the following visual checks and Mechanical Inspection** | **Results** |
|---|---|---|
| 1.1 | Check Name Plate details | _____ |
| 1.2 | Check for any loose connections. | _____ |
| 1.3 | Check for any bad insulation | _____ |
| 1.4 | Overheating | _____ |
| 1.5 | Damage or Displacement | _____ |
| 1.6 | Corrosion on Battery Terminals | _____ |
| 1.7 | Wires connection on terminals tightness | _____ |
| **2** | **Cleaning and Airflow** | |
| 2.1 | Ensure that the equipment is Clean | _____ |
| 2.2 | Check fan if fitted | _____ |
| 2.3 | Check all door and compartment air seals | _____ |
| **3** | **Electrical Inspection** | |
| 3.1 | Input Voltage | _____ |
| 3.2 | Input current | _____ |
| 3.3 | Input Frequency | _____ |
| 3.4 | Float/Equalize current limit | _____ |

| | | |
|---|---|---|
| 3.5 | DC Float Voltage at No Load | |
| 3.6 | DC Float Voltage at Load | |
| 3.7 | DC Equalize Voltage at No Load | |
| 3.8 | DC Equalize Voltage at Load | |
| 3.9 | Load Voltage | |
| | -At Float | |
| | -Al Equalize | |
| **4** | **ALARMS** | |
| 4.1 | AC mains failure | |
| 4.2 | Charger Voltage Low | |
| 4.3 | Charger Voltage High | |
| 4.4 | Charger Failure | |
| 4.5 | Ground Insulation<br>a) At Positive Pole b) At Negative pole | |
| 4.6 | Battery Circuits failure - monitoring | |
| 4.7 | Function of all measuring instruments | |
| 4.8 | Function of Lamp Test indication LED's | |
| 4.9 | DC distribution MCB's Tripped | |
| 4.10 | Voltage Dropping Diodes & bypass contactors function in accordance with the diagram | |
| **5** | **ENVIRONMENT** | |
| 5.1 | Battery Charger room temperature | |
| 5.2 | Air Conditioner provided in Battery room | |
| **6** | **TEST EQUIPMENT DETAILS** | |
| 6.1 | Rishi Multi 18S Digital Multimeter Sr. No - 066488<br>Calibration Due- April'09 | |
| 6.2 | HIOKI 3285-20 Digital AC/DC clamp meter Sr. No.080411739,<br>Calibration Due- May'09 | |

**General Comments:**

## 5. BATTERY READING SHEET

**CHARGING / DISCHARGING**

| DATE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| TIME | | | | | | | | | |
| CURRENT | | | | | | | | | |
| TOTAL VOLT | | | | | | | | | |
| TEMP S.G. | | | | | | | | | |
| BLOCK No. | V | V | V | V | V | V | V | V | V |
| BLOCK-1 | | | | | | | | | |
| BLOCK-2 | | | | | | | | | |

END OF SECTION- 2.3