TECHNICAL SPECIFICATION

SECTION: Ni-Cd BATTERY AND BATTERY CHARGER

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A) **TECHNICAL SPECIFICATIONS FOR NICKEL-CADMIUM BATTERIES**

1.0 Battery Ratings:

Battery Voltage	220V/110V/48V DC
Battery type	Nickel-Cadmium Battery with partial gas recombination- **Medium Discharge Rate as per IEC 62259**

2.0 Scope:

2.1 This specification covers the technical requirements and tests for partial recombination type Nickel-Cadmium alkaline batteries for use in 765/400/220kV sub-stations.

2.2 Scope covers the design, engineering, manufacture, testing at works, supply and commissioning of 220V/48V, Nickel – Cadmium Alkaline Battery. The 220V DC system is un-earthed, and 48V DC system is + ve earth system.

2.3 System requirement:

Nominal Voltage Rating of battery	**Nominal single cell voltage**	**Maximum voltage during Float operation**	**Maximum voltage during Boost operation**	**Nominal Number of cells**
(V)	**(V)**	**(V)**	**(V)**	**(V)**
48	1.2	52.80	54	37
110	1.2	121	123.5	85
220	1.2	242	248	171

3.0 CODES AND STANDARDS

All standards, specifications and codes of practice referred to herein, shall be the latest editions including all applicable official amendments and revisions as on date of opening of techno-commercial bid. In case of conflict between this specification and those (IS codes, Standards etc.) referred to herein, the former shall prevail. All works shall be carried out as per the following standards and codes:

IEC 62259	Nickel-cadmium partial gas recombination
IEC 60623/IS10918	Secondary cells and batteries containing alkaline or other non-acid electrolytes-vented Nickel Cadmium prismatic rechargeable single cells
IEC 60993	Electrolyte for vented Nickel-Cadmium cells
IEEE 1115	IEEE Recommended Practice for Sizing Nickel-Cadmium Batteries for Stationary Applications

3.0 GENERAL TECHNICAL REQUIREMENT

All materials/components used in battery chargers and batteries shall be free from flaws and defects and shall conform to the relevant Indian/IEC standards and good engineering practice.

The design of battery shall be as per field proven practices. Partial plating of cells is not permitted. Paralleling of cells externally for enhancement of capacity is not permitted. Protective covers shall be provided to prevent accidental contact with live electrical connections.

Battery must be capable of operation in temperature ranges of -15^0C to 45^0C for its expected service life. Air-conditioning shall be not applicable for battery rooms.

Batteries shall be suitable for a long life under continuous float operations and occasional discharges & shall have minimum expected battery life of 15 years in float operation.

3.1 Construction Features

3.1.1 Containers

Ni-Cd battery cell design shall be pocket/fibre plate. Containers shall be made of nonporous plastic material. Containers shall be robust, heat resistance, leak proof, non-absorbent, alkali resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. and should be translucent to facilitate checking of electrolyte level. Electrolyte level lines shall be marked on container in case of translucent containers to check the electrolyte level. The cells shall have prismatic, spill-proof and partial recombination type construction. Battery shall be ultra-low maintenance. Battery shall have provision for water top up to ensure electrolyte level does not fall below recommended level.

To ensure proper sealing of bushings vent-plugs/valves with flame arrestor feature shall be provided. Installation of the cells must ensure proper air circulation between the cells for heat dissipation/ventilation.

The container shall be capable of withstanding the rigours of transport, storage and handling.

3.1.2 Connectors and Fasteners

Nickel plated copper connectors shall be used for connecting adjacent cells and PVC insulated flexible copper cables shall be used for inter-row / inter-tier /inter-bank connections. Bolts, nuts, and washers shall be Stainless Steel/Nickel-coated steel to prevent corrosion. All the terminals and cells inter-connectors shall be fully insulated or have insulation shrouds

Suitable number of Inter-rack connectors shall be supplied by the Bidder to suit the battery room layout during detailed engineering.

3.1.3 Vent Plugs

Vent plugs shall be provided in each cell. They shall be anti-splash type, self-resealing and with flame arresting feature. In addition, the vent plug shall be easily removable for topping up the cells and of such dimensions that the syringe type hydrometer can be inserted into the cell to take electrolyte samples.

3.1.4 Plates

The plates shall be designed for maximum durability during all service conditions including medium rate of discharge and fluctuations of load. The positive and the negative electrodes shall be of pocket plate/fibre plate type and shall be able to absorb mechanical stresses & volume changes during charge/discharge cycles. Separators should be suitable for continuous immersion in the electrolyte without distortion. The separator shall also be dimensionally stable without deformation or determination at the temperatures of use.

3.1.5 Terminal Posts

Both the +ve and –ve terminals of the cells shall be capable of proper termination and shall ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell cover including bolt hole shall be coated with an alkali resistant and corrosion retarding material.

Terminal posts or any other metal part which is in contact with the electrolyte shall be made of the same alloy as that of the plates or nickel-plated or of a proven material that does not have any harmful effect on cell performance. Both +ve and –ve posts shall be clearly and unambiguously identified and marked. Cell terminals shall have current carrying capacity to meet the Ah rating of the battery as well as through fault short circuit current which the battery can produce and withstand for the period declared.

3.1.6 Sediment Space

Sufficient sediment space shall be provided so that cells will not have to be cleaned during normal life and prevent shorts within the cells.

3.1.7 Electrolyte

The electrolyte shall be prepared from battery grade potassium hydroxide conforming to IEC-60993. The cells can be shipped either in filled and charged condition or in dry condition. Necessary electrolyte for make-up (if required) shall be supplied separately. The cell shall contain sufficient reserve electrolyte for efficient heat dissipation & to reduce water topping up interval.

3.1.8 Battery racks

All batteries shall be mounted in a suitable metallic stand/frame. They shall be free standing type mounted on porcelain/hard rubber/PVC pads insulators/high impact plastic insulators. The bottom tier of stand shall have sufficient ground clearance above the floor to avoid grounding of frames/stand. Batteries having a complete cell weight of lower than 50 Kg can be located in the double tier arrangement

Racks shall be made of alkali resistant powder coated/plastic/epoxy coated steel or MS rack stainless steel or FRP to ensure corrosion resistance & to provide suitable protection against the effects of electrolyte spillage. Battery rack must have compact design to reduce installation footprint. Wherever racks are transported in dismantled conditions, match markings shall be provided to facilitate easy assembly.

Manufacturer's Identification System

The following information shall be indelibly marked on outside of each cell.

(a) Cell designation

(b) Manufacturers' name and trademarks.

(c) Nominal Voltage

(d) Country and Month/Year of manufacture.

(e) Manufacturer type designation.

(f) AH capacity at 5-hour discharge rate.

(g) Serial number

(h) Polarity Marking:

The positive terminal may be identified by 'P' or a '+' sign or red colour mark and the negative terminal may be identified by an 'N' or '—' sign or a blue colour mark. Marking shall be permanent and nondeteriorating.

3.2 Operational Requirements

The batteries shall normally be connected permanently to load in parallel with battery charger and shall supply load in emergency conditions in case of loss of AC supply. Batteries should be suitable for a long life under continuous float operations and occasional discharges.

3.3 Tests

All equipment to be supplied shall be of type tested design. During detail engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of techno-commercial bid opening.

These reports should be for the test conducted on the similar design to those proposed to be supplied under this contract and the test(s) should have been either witnessed by third party or by the client.

However, if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of techno-commercial bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner and same shall be witnessed by third party or by the clients representative and submit the reports for approval.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

3.3.1 Type Tests: as per IEC-62259:

i. Marking

ii. Dimensions

iii. Discharge performance at $+20^0$C.

iv. Discharge performance at $+5^0$C and -18^0C

v. High rate current

vi. Endurance of cycles

vii. Permanent charge endurance

viii. Charge acceptance at constant Voltage

ix. Charge retention

x. Electrolyte retention

xi. Determination of gas recombination of efficiency

xii. Storage

3.3.2 Acceptance Tests

The following shall constitute acceptance test and shall have to be preferred at Manufacturer's works prior to dispatch of the batteries.

a) Visual & physical examination. (Dimension, weight and layout).

b) Marking

c) Open circuit voltage, polarity and absence of short circuit

d) C5 capacity test

4.0 Packing and Dispatch:

The equipment shall be properly packed for transportation by rail or truck. The equipment shall be wrapped in polythene sheets before being placed in crates / cases to prevent damage. Crates/cases shall have skid bottoms for handling. Special notations such as "Fragile', "This side up" "Centre of gravity", "'Weight', "Owner's particulars", 'PO nos." etc, shall be clearly marked on the package together with other details as per purchase order. Contractor shall supply above packed material at required place as specified elsewhere.

5.0 Site Installation & Commissioning

Contractor shall be submitted following documents for approval:

a) Data sheet as per Annexure-I.

b) General Arrangement layout drawing.

c) Discharge Data

d) O&M Manual

All tests as listed below shall be carried out on sample cell selected at random by the employer at site after completion of installation.

a) Physical Examination

b) Dimensions, Mass & layout

c) Marking

d) Polarity and absence of short circuit.

C5 Capacity Testing on Bank- *(The manufacturer shall submit site capacity testing procedure with charge/discharge rate in accordance with IEC-62259,Section-7. In case Boost charging voltage specified in the procedure is unavailable in the installed charger on-site, then total cells may be distributed in two strings. Provision must be provided in the supplied bank to facilitate the same).*

5.1 Accessories

The following accessories shall be provided for routine maintenance of the battery system and the contractor shall supply 01 set per battery bank:

a) Alcohol thermometer

b) Torque wrench.

c) Cell test voltmeter (-3-0-+3) volts with least count of 0.01Volt.

d) Syringe type floating hydrometers.

e) One pair of Rubber gloves

f) Cell lifting puller-1 no.

g) Any other accessories deemed suitable by manufacturer.

6.0 Cell Booster

Cell booster shall be suitable for charging one to 10 cells Nickel Cadmium cells. It shall be suitable for charging not only new cells before being introduced to the battery bank but also for any treatment to be given to individual weak cells. Cell booster shall be suitable for 240V + 10%, 50 Hz + 3% SPN input power supply. Cell booster output voltage shall have provision to set the output voltage ranging from 0-18V Nickel Cadmium batteries. Cell booster shall be sized as under:

For Ni-Cd battery = 0.1 x Ah(C5) of cell.

Cell booster shall have a heavy-duty switch fuse or MCCB on both AC incomer and DC output sides, along with AC voltmeter, DC ammeter, DC voltmeter and indicating lamps for AC/ DC power ON. The output voltage and current of cell booster shall be manually controlled using a suitably rated Variac or a full wave-controlled rectifier bridge. Suitable interlock shall be provided so as to ensure that the Variac/controlled rectifier is at its minimum position while switching on the cell booster. Cell booster shall be portable type with wheels.

7.0 Defect Liability

The defect liability period for the battery shall be 03(Three) years from date of commissioning of battery.

8.0 Buyback of used/unserviceable batteries

Manufacturer shall buyback used/unserviceable batteries from the substations where batteries are replaced. The owner shall confirm the following particulars of used/unserviceable batteries to enable the bidder to quote buyback rates:

a) Type & number of cells for disposal
b) Make
c) Year of make/purchase
d) Capacity
e) Condition of cells

The bidder should quote their rates for buyback considering the salvage value of the above cells.

Safe disposal of unserviceable batteries- The bidder shall comply with latest guidelines of “Battery Waste Management Rules, 2022” issued by Ministry of Environment, Forest & Climate Change under Govt. of India.

B) Technical Specification for Battery Charger (for Ni-Cd Batteries)

1. General: The DC system for 220 V DC is unearthed and for 48 V DC is +ve earthed. The Battery Chargers as well as their automatic regulators shall be of static type and shall be compatible with offered Nickel-Cadmium batteries. All battery chargers shall be capable of continuous operation at the respective rated load in float charging mode, i.e. Float charging the associated Ni-Cd Batteries at 1.4 to 1.42 Volts per cell while supplying the DC load. The chargers shall also be capable of Boost charging the associated DC Battery at 1.53 to 1.85 Volts per cell at the desired rate. Battery charger should have the provision to charge battery cells with 1.85V/cell during the annual maintenance or deep discharge cell.

Charger shall regulate the float/boost voltage in case of prescribed temperature rise of battery as per manufacturer's recommendation to avoid thermal runaway. Necessary temperature sensors shall be provided in mid location of battery banks and shall be wired up to the respective charger for feedback control. The manufacturer shall demonstrate this feature during testing of each charger.

1.1 All Battery Chargers shall be provided with facility for both automatic and manual control of output voltage and current. A selector switch or front panel Keypad/HMI Touch screen display shall be provided for selecting the mode of output voltage/current control, whether automatic or manual. When on automatic control mode during Float charging, the Charger output voltage shall remain within ±1% of the set value, for AC input voltage variation of ±10%, frequency variation of ±5%, a combined voltage and frequency variation of ±10%, and a DC load variation from zero to full load.

1.2 **All battery chargers shall have a constant voltage characteristic throughout the range** (from zero to full load) at the floating value of the voltage so as to keep the battery fully charged but without harmful overcharge.

1.3 Efficiency of the battery charger under full load shall not be less than 90%.

1.4 All chargers shall have load limiters with a drooping characteristic. When the voltage control is in automatic mode, the load limiter shall cause a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the charger. The load limiter characteristics shall be such that any sustained overload or short circuit in the DC system shall not damage the charger, nor shall it cause the blowing of any of the charger fuses. The charger shall not trip on overload or external short circuit. After clearance of fault, the Charger voltage shall build up automatically when working in automatic mode.

1.5 Uniform and stepless adjustments of the voltage setting (in both manual and automatic modes) shall be provided on the front of the charger panel, covering the entire float charging output range specified. Stepless adjustments of the load limiter setting shall also be possible, ranging from 80% to 100% of the rated output current for charging mode.

1.6 During Boost Charging, the Battery Charger shall operate on constant current mode (when automatic regulator is in service). It shall be possible to adjust the Boost charging current continuously over a range of 50 to 100% of the rated output current for Boost charging mode.

1.7 The charger output voltage shall automatically rise when operating in Boost mode as the battery charges up. To limit the output voltage of the charger, a potentiometer or front panel keypad/HMI touchscreen shall be provided. This will allow the user to set the upper voltage limit anywhere within the output range specified for Boost charging mode.

1.8 The Charger manufacturer may offer an arrangement in which the voltage setting device for Float charging mode is also used as output voltage limit setting device for Boost charging mode and the Load-limiter of Float charging mode is used as current setting device in boost charging mode.

1.9 Suitable filter circuits shall be provided in all the chargers to limit the ripple content (peak-to-peak) in the output voltage to 1%, irrespective of the DC load level, when they are not connected to a battery.

2. MCCB

All battery chargers shall have **two** MCCBs on the input side to receive cables from two sources. A mechanical interlock shall be provided to ensure that only one MCCB is closed at a time. The MCCBs shall

in general conform to IS: 13947 Part-2 and suitable for continuous operation. Auxiliary contacts for annunciation shall be provided on the MCCBs.

3. Rectifier Assembly-

3.1 The rectifier assembly shall be a full-wave bridge type, designed to meet the duty requirements of the respective charger. Each rectifier cell shall have its own heat dissipation arrangement, utilizing natural air cooling. The rectifier shall use diodes/thyristors and heat sinks rated to **carry 200% of the load current continuously.** The temperature of the **heat sink shall not exceed 65°C** under maximum operating conditions, considering the maximum charger panel internal temperature.

3.2 The contractor shall submit calculations demonstrating the maximum junction temperature and heat sink temperature when operating at **200% and 100% load current** continuously, taking into account the maximum surrounding air temperature inside the charger panel, assuming an **ambient temperature of 40°C outside the panel.** Necessary surge protection devices and fast HRC fuses shall be provided in each arm of the rectifier connectors.

3.3 The **rectifier transformer** shall be continuously rated, dry air-cooled (A.N.), and of **Class F insulation type.** The rating of the rectifier transformer shall include a 10% overload capacity.

3.4 **Alternatively,** battery charger can have a modular construction with a rectifier topology utilizing **SiC MOSFET power semiconductors**. Each module shall incorporate a high-frequency transformer for galvanic isolation and loss reduction. It shall include automatic current-sharing control and N+1 redundancy to facilitate seamless system expansion.

Adequate cooling shall be provided within both the module and the charger panel to ensure proper heat dissipation, preventing thermal shutdown under full load conditions. The system shall incorporate built-in surge protection devices for both the overall charger and individual modules.

A single module failure shall not impact overall system performance. Faulty modules shall be hot-swappable, allowing replacement without shutting down the system, thereby ensuring continuous DC supply to connected plant load.

4. Instruments-

One AC voltmeter and one AC ammeter, along with selector switches, shall be provided for all chargers. One DC voltmeter and DC ammeter (with shunt) shall also be provided for all chargers. The instruments shall be flush type, dust-proof, and moisture-resistant. They shall include easily accessible means for zero adjustment and be of 1.5 accuracy class.

In addition to the above, a centre-zero voltmeter with a selector switch shall be provided for 220V chargers for testing purposes.

Alternatively, a front panel **HMI display** shall be provided to display the following measurements:

- AC Voltage (R-Y, Y-B, B-R, R-N, Y-N, B-N)
- AC Current (R, Y, B)
- AC Power
- AC Frequency
- DC Voltage
- DC Current
- Battery Voltage
- Battery Charge/Discharge Current
- Load Voltage
- Load Current

5. Air Break Switches-

One DC output switch shall be provided in all chargers. The switches shall be air-break type, suitable for **500 volts AC / 250 DC**. The contacts of the switches shall open and close with a snap action. The operating

handle of the switch shall be fully insulated from the circuit. The 'ON' and 'OFF' positions on the switch shall be clearly indicated. The rating of the switches shall be suitable for their continuous load. Alternatively, MCCBs of suitable ratings shall be acceptable in place of the air-break switch.

6. Fuses-

All fuses shall be HRC Link type. Fuses shall be mounted on fuse carriers which are in turn mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type base. In such case one insulated fuse pulling handle shall be supplied for each charger. Fuse rating shall be chosen by the Bidder depending on the circuit requirement. All fuses in the chargers shall be monitored. Fuse failure annunciation shall be provided on the failure of any fuse.

7. Blocking Diode-

The rectifier module shall be designed to prevent reverse current flow from the DC battery, ensuring no damage to the rectifier or other components. This protection shall be an inherent feature of the rectifier module. If not integrated, an external blocking diode shall be installed in the positive pole of each charger's output circuit to prevent reverse current flow from the DC battery into the charger.

8. Annunciation System-

Audio-visual indications through bright LEDs shall be provided in all Chargers for the following abnormalities:

a) AC power failure

b) Rectifier/chargers fuse blown.

c) Over voltage across the battery when boost charging.

d) Abnormal voltage (High/Low)

e) Any other annunciation if required.

Potential free NO Contacts of above abnormal conditions shall also be provided for common remote indication "**CHARGER TROUBLE**" in Owner's Control Board. Indication for charger in float mode and boost mode through indication lamps shall be provided for chargers. A potential free contact for float/boost mode shall be provided for external interlocks.

9. Name Plates and Marking-

The name plates shall be white with black engraved letters. On top of each Charger, on front as well as rear sides, larger and bold name plates shall be provided to identify the Charger. Name plates with full and clear inscriptions shall also be provided on and inside of the panels for identification of the various equipments and ease of operation and maintenance.

10. Charger Construction-

10.1 The chargers shall be indoor, floor-mounted, self-supporting, sheet metal enclosed cubicle type. The contractor shall supply all necessary base frames, anchor bolts, and hardware. The chargers shall be fabricated from **2.0mm cold-rolled sheet steel** and shall have a folded type of construction. Removable gland plates for all cables and lugs for power cables shall be supplied by the contractor. The lugs for power cables shall be made of electrolytic copper with a tin coating. Power cable sizes shall be advised to the contractor at a later date for provision of suitable lugs and gland plate drilling.

10.2 The charger shall be tropicalized and vermin-proof. If ventilation louvers are provided, they shall be backed with screens. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers shall have hinged double-leaf doors on the front and backside to allow adequate access to the charger's internals. All charger cubicle doors shall be properly earthed. **The degree of protection of the charger enclosure shall be at least IP-42, as per IS: 13947 Part I.**

10.3 All indicating instruments, control switches, and indicating lamps shall be mounted on the front side of the charger. Alternatively, a front panel Keypad/HMI touchscreen display shall be provided for measurement, selection, and indication purposes. This HMI shall be mounted on the front side of the charger panel.

10.4 Each charger shall be furnished completely wired up to power cable lugs and terminal blocks, ready for external connections. The power wiring shall be carried out with 1.1kV grade PVC insulated cables conforming to **IS:1554 (Part-1).** The control wiring shall be done with PVC insulated, 1.5 sq.mm. stranded copper wires. Control terminals shall be suitable for connecting two wires with 2.5 sq.mm stranded copper conductors. All terminals shall be numbered for ease of connection and identification. Each wire shall have a ferrule or tag at each end for identification. Power and control wiring within panels shall be kept separate.

10.5 Any terminal or metal work that remains live at voltages greater than 415V when the panel door is opened shall be fully protected by shrouding. At least **20% spare terminals** shall be provided for control circuits.

10.6 The insulation of all circuits, except for low-voltage electronic circuits, shall withstand a test voltage of **2kV AC for one minute.** An air clearance of at least 10mm shall be maintained throughout for such circuits, up to the terminal lugs. If this clearance is not available, the live parts shall be insulated or shrouded.

10.7 Electronic equipment shall be of modular design, consisting of plug-in moulded metallic racks with metallic card guides. The cards shall be provided with proper handles. Card-to-card wiring should preferably be through a motherboard. Unplanned jumpering and track modifications are not permitted. A mechanical interlock to prevent incorrect insertion of cards shall be provided. Each card shall have its junction and test points identified. Maintenance aids, such as extension printed wiring boards and jumper leads, shall also be provided.

10.8 The layout of charger components shall be such that their heat losses do not cause excessive temperature rise within the charger panel surface. The location of the electronic modules will be such that the temperature rise of the location will not exceed 10°C over the ambient air temperature outside the charger.

11. Painting-

All sheet steel work shall be pre-treated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be **"Class-C" as specified in IS:6005**. Welding shall not be done after phosphating. The phosphating surfaces shall be rinsed and passivated prior to application of stoved lead oxide primer coating. **After primer application, two coats of finishing synthetic enamel paint of shade-692 (smoke grey) of IS:5 shall be applied**, unless required otherwise by the Owner. The inside of the chargers shall be glossy white. Each coat of finishing synthetic enamel paint shall be properly staved. The paint thickness shall not be less than **fifty (50) microns.**

12. Tests-

12.1 Battery chargers shall conform to all type tests as per relevant Indian Standard. Performance test on the Chargers as per Specification shall also be carried out on each Charger. Rectifier transformer *(as applicable)* shall conform to all **type tests** specified in **IS: 4540 and short circuit test as per IS: 2026.** Following type tests shall be carried out for compliance of specification requirements:

a. Voltage regulation test
b. Load limiter characteristics test
c. Efficiency tests
d. High voltage tests
e. Temperature rise test
f. Short circuit test at no load and full load at rated voltage for sustained short-circuit.
g. Degree of protection test
h. Measurement of ripple by oscilloscope.
i. Temperature compensation feature demonstration

12.2 The Contractor may be required to demonstrate to the OWNER that the Chargers conform to the specification particularly regarding continuous rating, ripple free output, voltage regulation and load limiting characteristic, before despatch as well as after installation at site. At site the following tests shall be carried out:

a. Insulation resistance test
b. Checking of proper annunciation system operation.

12.3 If a Charger fails to meet the specified requirements, the Contractor shall replace the same with appropriate Charger without affecting the commissioning schedule of the Sub-station, and without any extra cost to the OWNER.

12.4 The Contractor shall present for inspection, the type and routine test certificates for the following components whenever required by the OWNER.

i. Switches.
ii. Relays/ MCCBs
iii. Instruments.
iv. DC fuses.
v. SCR.
vi. Diodes.
vii. Condensers.
viii. Potentiometers.
ix. Semiconductor
x. Annunciator.
xi. Control wiring
xii. Push buttons and contactors.

Makes of above equipment shall be subject to Owner's approval.

APPLICABLE STANDARDS FOR BATTERY CHARGER:

The battery charger and accessories shall strictly conform to the latest revisions of Indian and International standards, Indian Electricity Rules and other applicable statutory rules, regulations and provisions.

Some of the applicable standards are listed below for ready reference, however, this does not form the exhaustive and complete list of applicable standards:

S.No.	Standard No.	Applicable for
1.	IS 3895 : 1966	Mono-crystalline semiconductor rectifier cell and stacks
2.	IS:13703 : 1993 (Part 1 to 4)	Low voltage fuses
3.	IS: 1248 (Part 1 to 9)	Direct acting indicating analogue electrical measuring instruments and their accessories
4.	IS: 13947 : 1993 / 2004	Low-voltage switchgear and control-gear
5.	IS: 5578 : 1985	Guide for marking of insulated conductors
6.	IS: 11353 : 1985	Guide for uniform system of marking and identification of conductors and apparatus terminals
7.	IS: 4540 : 1968	Mono-crystalline semiconductor rectifier assemblies and equipment
8.	IS: 6619 : 1972	Safety code for semiconductor rectifier equipment
9.	IS: 11171:1985	Dry Type Transformer
10.	IS: 6005 : 1970	Code of practice for Phosphating of iron and steel
11.	IS : 3231 (Part 1 to 3)	Electrical relays for power system protection
12.	IS: 3842 (Part 1 to 12)	Application guide for electrical relays for AC systems

13.	IS: 5 : 1994	Colors for ready mixed paints and enamels
14.	IS: 5921 (Part 1 to 12)	Metal-clad base materials for printed circuits for use in electronic and telecommunication equipment

BATTERY SYSTEM DATA SHEETS

S.No.	Description of Data	Unit	220/110V	48V
1	**General Data**			
a)	Battery Type & Designation:			
i	Valve regulated or catalytic recombination type			
ii	In case of catalytic of recombination type, frequency of replacement of catalytic converter			
iii	Release pressure for valve regulated type	Kg/m2		
b)	Does each battery and battery [rack]/ [cabinet] meet the seismic requirements	[Yes] [No]		
c)	Manufacturer's Designed Life of Battery	Yrs		
d)	Recommended Battery Charger Data:	-		
i	Floating voltage range	V		
ii	Boost charge	V		
iii	Current rating	Amps.		
iv	Recharge time	hr		
e)	Heat Released During:	-		
i	Discharge duty cycle	Watt		
ii	Float charge	Watt		
iii	Boost Charge	Watt		
f)	Time Battery may be Stored Without a Freshening Charge	months		
g)	Temperature Compensation Provided and its Details	-		
2.	**Physical Description.**			
a)	**Battery Cell:**			
i	Size (L x W x H)	mm		
ii	Weight	Kg		

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iii	Net Dry weight	Kg		
iv	Volume of electrolyte	L		
v	Container Type & Material	-		
vi	Separator material	-		
vii	Retainer material	-		
viii	Internal resistance of cell	ohm		
b)	**Electrolyte**			
i	Particulars			
ii	Maximum period of storage prior to first charge			
iii	Specific gravity per cell at 27 degc			
iv	Volume of electrolyte per cell	ml		
v	Volume of reserve electrolyte per cell	ml		
c)	**Battery [Rack] [Cabinet]:**			
i	Outline or catalogue number			
ii	No. of cells per rack			
iii	Quantity of [racks][cabinets] for the battery			
iv	Description (tier or step type)			
v	Dimension of rack in mm			
d)	Total Net Weight of Battery Including [Racks] [Cabinets]	kg		
e)	Total Shipping Weight of Each Battery Jar and Associated Equipment	kg		
f)	**Connectors**:			
i	Intercell:			
ii	Type			
iii	Material			
iv	No. per connection			

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g)	**Inter-[Tier] [Step]:**			
i	Type			
ii	Material			
iii	No. per connection			
iv	Terminal Detail:			
v	Type			
vi	Material			
h)	**Torque Data:**			
i	Intercell Connectors			
ii	Inter-[Tier] [Step]:			
3.	**Performance Data.**			
i	Battery String Designation No.			
ii	Float Voltage Without Boost	V/cell		
iii	Float Voltage with Boost	V/cell		
iv	Boost Charge Voltage	V/cell		
v	End cell Voltage	V/cell	1.0V	1.0V
vi	Recombination efficiency	%		
vii	Recommended Frequency of Boost Charge			
viii	Recommended Duration of Boost Charge			
ix	Open-Circuit Voltage	V/cell		
a)	Short-Circuit Current at Battery Terminals at Float Voltage at (27°C):			
b)	Battery Discharge Characteristics	A or A /positive plate		
c)	Guaranteed Amp-Hour Capacity (at the 5-hr rate) to Specified End Voltage	AH		
i	One minute	A/cell		
ii	Thirty minutes	A/cell		

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iii	One-hour	A/cell		
iv	Five-hour	A/cell		
d)	Dispatch condition of battery			
e)	Battery Room Ambient Temperature Range	(°C to °C)		
f)	Maximum temperature at which battery can be stored	°C		