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Ni-Cd ALKALINE BATTERIES (PARTIAL RECOMBINATION TYPE) WITH CHARGERS FOR 33/11 KV AND 66/11 KV SUB-STATIONS

Foreword

REC Specification No.34/1984 (Revised 1987) is available for 24 V Ni-Cd battery with charger for 33 or 66/11 kV substations. Development in the field of battery technology & electronics have necessitated revision of this standard. It has been observed that most of the 3 utilities presently are using sealed maintenance free lead-acid batteries in the substations but the life of the batteries is around 2 years. Ni-Cd battery technology is definitely superior to lead-acid technology with increased life expectancy of about 15 years. Also Ni-Cd batteries are able to withstand rough handling. Initially Ni-Cd technology was not matured but now this technology has proven its merits & it is therefore advisable that only Ni-Cd batteries are used in substations. The initial cost of Ni-Cd batteries may be higher, but due to the improved system availability & reliability, lower maintenance & longer life, the utilities can recover the cost within a short period. Maintenance requirement of these batteries is much lower than Lead-acid batteries. Presently four suppliers of Ni-Cd batteries are available in India, namely- HBL Power Systems, Hyderabad; Hoppecke, Chennai; Amcosoft, Bangalore & High Energy Batteries (India) Ltd., Pudukottai, Tamilnadu.

The specification is in two parts, Part-A for Ni-Cd battery & Part-B for battery charger. The utilities in India may use these specifications and may share their experiences with REC for improvement in the technical specifications.

In the specifications, following aspects/facilities need to be properly specified by the utilities: -

- a) Testing requirements need to be agreed between the utility & supplier.
- b) Voltage level of DC system.
- c) Battery capacity in Ah has been worked out for 24 V DC system. In case utility is using different voltage level, the capacity may be modified accordingly.
- d) Indoor/outdoor requirement.
- e) The performance & life of Fibre plate type Ni-Cd batteries is superior than pocket plate type Ni-Cd Batteries & utilities may choose to specify only Fibre plate Ni-Cd batteries.

Part-A

Ni-Cd ALKALINE BATTERIES (PARTIAL RECOMBINATION TYPE) FOR 33/11 KV AND 66/11 KV SUB-STATIONS

1. SCOPE

This specification covers the requirements and tests for 24 V, 30 V 110 V, 220V partial recombination type Nickel-Cadmium alkaline batteries with chargers, for use in 33/11 KV and 66/11 KV sub-stations.

The batteries covered in this specification are for indoor use. For out-door application a suitable enclosure shall be provided. ~~preferably made of an insulating material like FRP/SMC/Poly carbonate plastic material with heat/alkali/humidity/UV resistance confirming to IS: 13410 or other relevant international standard having rain proof ventilating louvers shall be provided.~~ **The enclosures shall confirm to IP: 53 degree of protection.**

2. APPLICABLE 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 bid. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. Unless otherwise modified in this specification, the Ni-Cd batteries shall comply with latest version of IEC 62259.

All work shall be carried out as per the following standards and codes.

Sl.No.	International Standards	Indian Standards	Description
1	IEC: 62259	-	Secondary cells and batteries containing alkaline or other non-acid electrolytes-Nickel-cadmium prismatic secondary single cells with partial gas recombination
2	IEC: 60623	IS: 10918	Secondary cells and batteries containing alkaline or other non-acid electrolytes-vented Nickel_Cadmium prismatic rechargeable single cells
3		IS: 1146	Rubber & Plastic container for lead acid storage batteries

Sl.No.	International Standards	Indian Standards	Description
4	IEEE: 1106		Recommended practice for maintenance, testing & replacement of Ni-Cd storage batteries for generating stations & substations
5	IEEE: 1115		Recommended practice for sizing of Ni-Cd batteries for stationary applications
6		IS 13410	Glass reinforced Polystar sheet moulding compounds.
7		IS: 1248	Voltmeter

3. STANDARD RATING

The standard voltage ratings of batteries for use at 33/11 KV and 66/11 KV substations shall be 24 volts or 30 volts or 110 volts or 220 volts. The batteries for the above application shall have a rating of 45 Ah (Minimum) in case of 24 V battery system or as per the load requirement of the substation.

For batteries intended for use with individual or groups of breakers, lower Ah ratings can be used depending upon the requirements.

4. CELL VOLTAGE

The nominal voltage of a single cell shall be 1.2 V

Nominal Voltage Rating of battery	Nominal single cell voltage	Float cell voltage	Number of cells (to be finalized)	Permissible D.C. System voltage variation	End of discharge cell voltage (Min.)
(V)	(V)	(V)	(V)	(V)	(V)
24	1.2	1.4 to 1.42	19	21.7 to 27	1.14
30	1.2	1.4 to 1.42	23	26.2 to 32.7	1.14
110	1.2	1.4 to 1.42	87	99.2 to 123.5	1.14
220	1.2	1.4 to 1.42	170	193.8 to 241.4	1.14

Note: As the nominal cell voltage is 1.2 V, nominal battery bank voltage may not exactly match nominal DC system voltage.

5. CAPACITY AT 20⁰C TEMPERATURE

Battery capacity shall be decided based on the following load cycle:-

- (a) 800W for 1/2 minute to end cell voltage of not less than 1.14 V per cell considering loads (i) to (iv) below.
- (b) 300 W for 1 hour to end cell voltage of not less than 1.14 V per cell considering loads (iii) & (iv) below.
- (c) 100W for 05 hrs to end cell voltage of not less than 1.14 V per cell considering loads (iv) below.

The load cycle has been decided based on the following considerations:-

- (i) Tripping of 03 Nos. circuit breakers simultaneously with battery for which a total load of 500 W has been considered.
- (ii) Closing of 3 circuit breakers one after the other for which a load of 500 W per circuit breaker has been considered.
- (iii) Emergency lighting load of 200 W for 01 hour.
- (iv) 100 W load for panel indication lamps, relays, PLCC/ VHF communication systems, computer etc. for a period of 06 hours.

6. BATTERY SIZING

The supplier shall carry out battery sizing calculations based on the load cycle specified in line with IEEE 1115 and submit the same to the owner justifying the type/number of cells considered against the requirement.

Following factors shall be considered while carrying-out battery sizing calculations:-

- a) Ageing factor – 1.25
- b) Design margin –1.0
- c) State of charge –0.9

The number of cells shall be determined as per load cycle and the battery system voltage level. The owner, if required for the battery system, may specify provision for the number of spare cells.

7. CONSTRUCTION

The cells shall have prismatic, spill-proof and valve-regulated partial recombination type of construction with partial recombination feature. The cells shall be flooded type containing sufficient reserve electrolyte. Battery shall be equipped with nickel-plated inter-cell connectors and terminals. The cells shall be housed in high-strength

impact resistant & alkali-resistant containers and should be transparent / translucent to facilitate checking of electrolyte level. Container and Lid should be welded and should not cause leakage of electrolyte/gases during operation even in case of normal mechanical/electrical abuses. O-rings of nitrile rubber with EPOXY sealing shall be used to ensure proper sealing of bushings etc. Flip-top vent plugs/ valves with flame arrester feature shall be provided. The regulating valve type design shall be of self-resealing type. Construction of cells shall be to ensure proper air circulation between the cells for heat dissipation/ ventilation (by providing either insulated button separators integral with the outer surface of the cell container or by suitably designing the inter cell connectors). The containers shall be strong enough, so that excessive bulging of container does not occur during service. Cells shall be supplied in filled & charged state or otherwise electrolyte dry form & battery water separately or in liquid form shall be shipped as desired by the owner.

Battery shall have provision for water top up to ensure electrolyte level does not fall below recommended level.

8. ELECTRODES

+ ve and -ve electrodes shall be made by encapsulating/impregnating active material in order to ensure that the battery is able to perform reliably over its life. +ve and -ve electrodes shall be separated by micro porous separators. The structure of electrodes shall be elastic enough to absorb mechanical stresses & volume changes during charge/discharge cycles.

9. ELECTROLYTE

The electrolyte shall be prepared from battery grade potassium hydroxide (KOH) confirming to IEC 60993. The cells shall contain sufficient reserve electrolyte for efficient heat dissipation & to reduce water topping up interval. Reserve electrolyte shall not be less than 06 ml/Ah.

10. CONNECTORS

Nickel plated copper intercell connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be nickel-plated steel/stainless steel. All terminals and cell inter-connectors shall be fully insulated or have insulation shrouds.

11. TERMINALS

Separate terminals shall be provided on the end cell for connecting load through DCDB and for connecting charger leads. All terminals shall be of suitably sized nickel-plated steel. Suitable nickel-plated copper lugs shall be provided by the supplier for use of the purchaser for connecting up the load wiring. All connectors

and leads shall be suitable for carrying 30-minute discharge current continuously and rated for short circuit duty of 4kA for 01 second.

12. MANUAL OF INSTRUCTIONS

The manufacturer shall supply a copy of the instruction manual for commissioning & initial treatment of the battery and maintenance during service with every battery bank ordered.

13. RECOMBINATION EFFICIENCY

In order to reduce topping-up frequency, recombination of Hydrogen & Oxygen gases evolved during charging/discharging shall be achieved by using safe and reliable technology such as catalytic conversion/valve regulation technique or both. Minimum recombination efficiency shall be 80%. Recombination efficiency test shall be done in accordance with IEC 62259. In case the batteries are operated at high temperatures & are frequently boost charged the water consumption may be higher & topping-up frequency may increase.

14. BATTERY RACKS

Suitable corrosion resistant battery racks and cable supports shall be provided. Metallic racks shall be properly earthed. The bottom tier of stand shall have a ground clearance of 150mm minimum above the floor. Racks shall be made of alkali resistant powder coated steel or stainless steel or FRP to ensure corrosion resistance.

15. TEMPERATURE RANGE

Battery must be capable of continuous operation in temperatures range of -15 °C to +50°C for prolonged periods. No Air-conditioning shall be provided where batteries are to be installed.

16. ACCESSORIES

The following accessories (BIS certified) shall be supplied with each set of battery:-

- i) Clamp-on type digital multi-meter of AC/DC current range having ISI mark.
- ii) Pair of gloves
- iii) 10" Slide insulated wrench for opening terminal nuts
- iv) Plastic/glass syringe
- v) Alcohol thermometer
- vi) Hydrometer for use while filling electrolyte.

17. CHARGE RATE

Fully discharged batteries should be able to get recharged in 7 hours maximum to 90% of capacity with charging current in the range of 0.1 to 0.4C5 rate at 20°C. At higher temperatures, the charging time may be more. The trickle charge rate shall be 1-2 mA/Ah.

18. CELL DESIGNATION

The practice as per IS: 10918 (latest version) shall be followed.

19. POLARITY MARKING

The polarity of the terminals shall be marked for identification. Positive terminal may be identified by 'P' or a (+) sign or red colour mark and negative terminal may be identified by 'N' or (-) sign or blue colour mark. Marking shall be permanent and non-deteriorating.

20. WARNING MARKING

The battery shall be furnished with a warning plate located at conspicuous place specifying the use of 'ALKALINE ELECTROLYTE ONLY' (in block letters) and specifying proper filling level of the electrolyte. Marking shall be permanent and non-deteriorating.

21. PACKING

The batteries shall be securely packed in wooden crates suitable for handling during transit by rail/road and secured to avoid any loss or damage during transit. Carton boxes duly palletized shall also be acceptable.

22. TESTS

The batteries shall be tested for type, acceptance and routine tests in line with IS: 10918 & IEC: 62259 (latest versions). The owner may at their discretion to accept the batteries based on type tests already carried-out. In such cases, Type test reports for tests carried out not earlier than 05 years from bid opening date from NABL accredited labs shall be acceptable.

Note : In case Type tests are repeated, life cycle test may not be insisted upon Ni-Cd battery of the specific ratings to be ordered, as this test takes a long time (2-3 years). However, satisfactory evidence is to be furnished for having made this test on cell of any other Ah capacity of the same design.

23. 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:

- i) Type & number of cells for disposal
- ii) Make
- iii) Year of make/purchase
- iv) Capacity
- v) Condition of cells

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

24. SAFE DISPOSAL OF UNSERVICEABLE BATTERIES

The bidder shall have facilities for proper treatment & disposal of used/unserviceable batteries that are bought back from the users, in line with the environmental protection rules & regulations of the country.

25. GUARANTEE

The batteries shall be guaranteed for a period of 36 months from the date of commissioning.

GUARRANTEED TECHNICAL PARTICULARS

Name of manufacturer :

Address :

Sl.No.	Description	Units			
1	Rated DC system voltage	Volts			
2	Rated cell voltage	Volts			
3	Number of cells	Nos.			
4	Cell designation				
5	Type of electrode				
6	Specific gravity of electrolyte				
7	Cell float charge voltage	Volts			
8	Cell boost charge voltage	Volts			
9	End Cell voltage	Volts			
10	Nominal cell capacity at 5 Hrs rate	Ah			
11	Material of container				
12	Size of terminals				
13	S/C rating of terminals/ connectors/ leads	kA			
14	Current for charge to 90% capacity in 7 Hrs from fully discharged state	Amps			
15	Recombination efficiency	%			
16	Valve regulated or catalytic recombination type				
17	In case of catalytic recombination type, frequency of replacement of catalytic converter				
18	Release pressure for valve regulated type	Kg/m ²			
19	Volume of electrolyte per cell	ml			
20	Volume of reserve	ml			

Sl.No.	Description	Units			
	electrolyte per cell				
21	No of electrode plates per cell	Nos.			
22	Type of racks				
23	Cell dimension: (a) Height (b) Width (c) Depth	mm mm mm			
24	Rack Dimensions (a)Height (b)Width (c)Depth	Mm Mm mm			
25	Recycling facilities for unserviceable batteries available or not	Y/N			

Part - B

CHARGER FOR Ni-Cd BATTERY (RECOMBINATION TYPE)

1. SCOPE

This specification covers the requirements and tests for Battery charger for partial recombination type Nickel-Cadmium alkaline batteries for use in 33/11 KV and 66/11 KV sub-stations.

2. CODES AND STANDARDS

2.1. 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 bid. In case of conflict between this specification and those (IS codes, standards etc.) referred to herein, the former shall prevail. All work shall be carried out as per the following standards and codes.

Sl.No	Internatioonal standards	Indian standards	Description
1		IS:5	Colours for ready mix paints.
2		IS : 1248	Specification for Direct acting indicating analogue electrical measuring instruments.
3	IEC : 947-1	IS : 13947 Prt-1	Degree of protection provided by enclosures for low voltage switch gear and control gear.
4	IEC : 947-2	IS : 13947 Prt.-2	Low voltage circuit breaker
5	IEC : 947-3	IS : 13947 Prt-3	Specification for low voltage switch gear and control gear.
6	IEC : 947-4	IS : 13947 Prt-4	Contactors
7	IEC:439	IS:8623	Low voltage switch-gear and control-gear assembly
8		IS:8686	Static protective relays

Sl.No	International standards	Indian standards	Description
9	IEC: 337	IS:6875	Control switches
10	IEC:225	IS : 3231	Electrical relays for power system protection.
11		IS : 3842	Application guide for Electrical relays for AC System
12	IEC 146	IS : 3895	Mono-crystalline semi-conductor Rectifier Cells and Stacks.
13	IEC 146	IS : 4540	Mono crystalline semi-conductor Rectifier assemblies and equipment.
14		IS:6619	Safety Code for Semi-conductor Rectifier Equipment.
15		IS:6875	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto 1000 V AC or 1200 V DC.
16		IS : 9000	Basic environmental testing procedures for electronic and electrical items.
17	IEC:60269	IS:13703 Prt-4	Low voltage fuses for protection of semiconductor devices.
19		IS:1901	Visual indicating lamps
20		IS:6005	Code of practice for phosphating of Iron and Steel.
21	IEC :227	IS:694 /IS: 1554	PVC Insulated Cable for working voltages upto and including 1100 V.

- 2.2. Equipment complying with other internationally accepted standards such as IEC, BS, VDE. etc. will also be considered if they ensure performance and constructional features equivalent or superior to standards listed above. In such a case, the Bidder shall clearly indicate the standard(s) adopted, furnish a copy in English of the latest revision of the standards along with copies of all official amendments and revisions in force as on date of opening of bid and shall clearly bring out the salient features for comparison.

3. EQUIPMENT DESCRIPTION

- 3.1. a) The Battery Chargers as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in Float mode, i.e. Float charging the associated Ni-Cd Batteries (partial recombination type) while supplying the D.C. loads. The Batteries shall be Float charged at 1.4 to 1.42 Volts per cell. All chargers shall also be capable of Boost Charging the associated Batteries at 1.53 to 1.7 Volts per cell at the desired rate. The Chargers shall be designed to operate, as mentioned above, **up-to** an ambient air temperature of 50°C. Tapping arrangement in the battery bank shall be provided to limit the over-voltage for supplying load within allowed voltage range under boost charge conditions. The charger should automatically switchover to float charge & to boost charge when the specified limit of voltage is approached. However, necessary timer circuit shall be used to allow a finishing charge before switching over to float mode, as recommended by battery manufacturer in order to ensure that battery gets fully charged. The charger rating, tapping cell and specified voltages for automatic changeover to float/boost mode shall be as given in table below:

Rating of Charger	Charger Rating during Float Charging at 1.4 to 1.42 V per cell	Charger Rating during Boost Charging at 1.53 to 1.7 V per cell	Tapping to be provided at ---th cell	Switching Voltage to Boost Mode	Switching Voltage to Float Mode
Volt	Ampere	Ampere	n	Volt	Volt
24	10	25	15	21	32
30	10	25			
110					
220					

- b) Battery Chargers shall automatically select the appropriate mode of operation i.e. Float or Boost. Means shall be provided to avoid current/voltage surges of harmful magnitude/nature, which may arise during changeover.
- c) Soft start feature shall be provided to build up the voltage to the set value slowly within fifteen seconds. The chargers shall have load limiters, which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the Charger. The load limiter characteristic shall be such that any sustained overload or short circuit in DC system shall neither damage the Charger nor shall it cause 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.

During external short circuit, output of the charger shall be automatically reduced to near zero volt till it is not isolated/disconnected & normal output voltage shall be restrained by charger ckt on isolation with out any harm to source transformer/protection/ regulator ckt

- d) During Float charging, the Charger output voltage shall remain within $\pm 1\%$ of the set value for AC input voltage variation of $230 +10\%$, -15% frequency variation of $\pm 5\%$, a combined voltage and frequency (absolute sum) variation of 10% and a continuous DC load variation from 5% to full load. Uniform and stepless adjustments of voltage setting shall be provided on the front of the Charger panel covering the entire Float charging output range specified. Stepless adjustment of the load limiter setting shall also be possible from 80% to 100% of the rated output current for Float charging mode.
- e) During Boost charging, the Battery Chargers shall operate on constant current mode with maximum current limiter setting (When automatic regulator is in service).
- f) Energising the Charger with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of the voltage setting. Time taken to stabilise, to within the specified limits in clause 2.01.00 (e), shall be less than five seconds.
- g) Momentary output voltage of the Charger, with the Battery connected shall be within 90% to 110% of the voltage setting during sudden load Change from 80% to 20% of full load or vice-versa. Output voltage shall return to, and remain, within the limits specified in clause 2.01.00 (e) in less than 1 second after the above mentioned change.
- h) 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 the float charging mode is also used as Boost charging current setting device.

- i) Suitable filter circuits shall be provided in all the Chargers to limit the ripple content (peak to peak) in the output voltage to **3 %** irrespective of the DC load, even when they are not connected to a battery.
- j) The DC System shall be ungrounded and float with respect to the ground potential when healthy.
- k) Battery shall be isolated in case of short circuit on the load side.
- l) Battery test circuit shall be provided with suitable resistance for discharging the battery for 30Sec at 5 hr rate.
- m) All potentiometers shall be electronically locked to contain the various parameters within allowable limits even if the setting position of potentiometers is changed to extreme positions.
- n) Insulation resistance shall be 5 M Ohm min.

3.2. MCB

An MCB shall be provided at the incomer.

3.3. Rectifier-Transformers and Chokes

The rectifier transformer and chokes shall be dry and air cooled (AN) type. The rating of the rectifier-transformers and chokes shall correspond to the rating of the associated rectifier assembly. The rectifier-transformers and chokes shall have class-B insulation. Rectifier transformer shall confirm to all type tests as specified in IS 4540/IS 2026. Type test & routine test reports shall be submitted to the owner.

3.4. Rectifier Assembly

The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective Charger. The rectifier cells shall be provided with their own heat dissipation arrangement with natural air cooling. The rectifier shall utilise diodes/thyristors with heat sinks rated to carry 130% of the load current continuously and the temperature of the heat sink shall not be permitted to exceed 85°C absolute duly considering the maximum temperature inside charger panel. The Contractor shall submit calculations to show what maximum junction temperature will be and what the heat sink temperature will be when operating at 130% and 100% load current continuously duly considering the maximum surrounding air temperature for these devices inside the charger panel assuming ambient temperature of 50°C outside the panel. Necessary surge protection devices and rectifier type fast acting fuses shall be provided in each arm of the rectifier connections.

Design having IGBT or superior technology shall also be acceptable for which full justification & experience shall be required for acceptance. Static silicon controlled rectifiers and diodes complete with resistor/capacitor network for surge protection shall be provided

3.5. Instruments

Analog or digital D.C. voltmeter, D.C. ammeter and A.C. voltmeter with 96 mm square display shall be provided for all Chargers. The instruments shall be flush mounted type, dust proof and moisture resistant. The instruments shall have easily accessible means for zero adjustments. The instruments shall be of 1.5 accuracy class.

3.6. Control and Selector Switches

Control and selector switches shall be of rotary stayput type of reputed make, confirming to relevant IS with escutcheon plates showing the functions and positions. The switches shall be of sturdy construction and suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred. The contact ratings shall be at least the following :

- i) Make and carry continuously - 10 Amps.
- ii) Breaking current at 220 V DC - 0.5 Amp. (Inductive)
- iii) Breaking current at 240 V AC - 5 Amp. At 0.3 p.f.

3.7. Fuses

Fuses shall be of HRC cartridge fuse link type. Fuses shall be mounted on fuse carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on fuse carriers, fuses shall be directly mounted on plug in type bases. In such cases one insulated fuse pulling handle shall be supplied for each charger. Suitable fuse fail detector circuits with alarm contacts shall be provided for all D.C. fuses.

3.8. Indicating Lamps

The indicating lamp shall be of panel mounting, LED type and capable of clear status indication under the normal room illumination. The lamp covers shall be preferably screwed type, unbreakable and moulded from heat resistant material.

3.9. Blocking Diode

Blocking diode with full redundancy shall be provided in the output circuit of each Charger to prevent current flow from the D.C. Battery into the Charger.

3.10. Annunciation System

Visual indications through indicating lamps/LEDs or annunciation facia shall be provided in all Chargers for the following:

- i. A.C. supply failure
- ii. Rectifier fuse failure
- iii. Surge circuit fuse failure
- iv. Filter fuse failure
- v. Load limiter operated
- vi. Charger trip
- vii. Battery on Boost
- viii. Load-side DC under-voltage & over-voltage alarm
- ix. Battery side DC over-voltage alarm
- x. AC available – Battery discharge (Mains available battery discharge) alarm
- xi. Potential free NO contacts shall be provided for following remote alarms:
 - a) Battery on boost
 - b) Charger trouble (this being a group alarm initiated by any of the faults other than 'Battery on Boost')

3.11. Name Plates and Marking

The nameplates shall be made of non-rusting metal/3 ply Lamicoid and shall have black back-ground with white engraved letters and secured by screws. These shall be provided near top edge on the front as well as on rear side of Charger. Nameplates with full and clear inscriptions shall also be provided on and inside the panels for identification of the various equipment.

- 3.12.** Detailed dimensional drawings, commissioning and operating instructions and Test Certificates of the manufacturer shall be supplied with the equipment.

4. CONSTRUCTION

- 4.1.** 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 Charger shall be fabricated using cold rolled sheet steel not less than 1.6 mm thick. The panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. Removable un-drilled gland plates of at least 3.0 mm sheet steel and lugs for all cables shall be supplied by the Contractor. The lugs for cables shall be made of electrolytic copper with tin coat. Cable sizes shall be advised to the Contractor at a later date for provision of suitable lugs and gland plates. Ventilation louvers shall be backed with fine brass wire mesh. All doors and covers shall be fitted with nitrile/neoprene/PU rubber gaskets. The Chargers shall have hinged double leaf doors provided on front and/or backside for adequate access to the Charger internals. All the Charger cubicle doors shall be properly earthed. The degree of protection of Charger enclosure shall be at least IP-42 as per IS:2147. The construction shall meet the requirements of IS 6619. All equipment mounted in the cabinet shall be provided with individual labels with equipment designation engraved.

- 4.2. In case of outdoor mounting the charger shall be provided with double doors on both front & back and shall pass IP-42 requirement with one door open on both sides. The enclosure shall be provided with a canopy.
- 4.3. The layout of Charger components shall be such that their heat losses do not give rise to excessive temperature within the Charger panel. Location of the electronic modules will be such that temperature rise, in no case, will exceed 10°C over ambient air temperature outside the Charger.
- 4.4. Each Charger panel shall be provided with an illuminating lamp (CFL or tube-light) and one 5 Amp. Socket. Switches and fuses shall be provided separately for each of the above.
- 4.5. Locking facilities shall be provided as following:
 - a) For locking Float/Boost selector switch in the float position only.
 - b) The Charger enclosure door shall have provision for padlocks. Padlocking arrangement shall allow ready insertion of the padlock shackle but shall not permit excessive movement of the locked parts with the padlock in position.

4.6. Wiring

- 4.6.1. Each Charger shall be furnished completely wired upto power cable lugs and terminal blocks ready for external connection. The power wiring shall be carried out with 1.1 kV grade PVC insulated cables conforming to IS:1554 (Part-I). The control wiring shall be of 1.1kV grade PVC insulated stranded copper conductors of 1.5 sq.mm. minimum, conforming to IS:694. Control wiring terminating at electronic cards shall not be less than 0.75 sq. mm. Control terminal shall be suitable for connecting two wires of 1.5 sq.mm. stranded copper conductors. All terminals shall be numbered for ease of connections and identification. At least 20% spare terminals shall be provided for circuits.
- 4.6.2. Power and control wiring within panels shall be bundled separately. Any terminal or metal work which remains alive at greater than 415 V, when panel door is opened, shall be fully protected by shrouding.
- 4.6.3. An air clearance of at least ten (10) mm shall be maintained throughout all circuits, except low voltage electronic circuits, right upto the terminal lugs. Whenever this clearance is not available, the live parts should be insulated or shrouded.

4.7. Painting

Pre-treatment & phosphating with 7 tank process shall be provided as per IS: 6005. The phosphate coating shall be 'class-C' as specified in IS: 6005. Electrostatic

powder painting with final shade – 692 (smoke grey) of IS: 5 shall be provided. The thickness shall not be less than 50 microns.

5. PACKING & dispatch

The equipment shall be dispatched securely packed in wooden crates suitable for handling during transit by rail/road so as to avoid any loss or damage during transit.

6. QUALITY ASSURANCE PLAN

6.1. The vendor shall furnish the following information along with his bid; failing which the bid shall be liable for rejection. Information shall be separately given for individual type of material offered.

- i) The structure of Organization
- ii) The duties and representatives assigned to staff ensuring Quality of work
- iii) The system of purchasing, taking delivery and verification of materials
- iv) The system for ensuring quality of workmanship
- v) The quality assurance arrangements shall conform to the relevant requirement of ISO 9001 or ISO 9002 as applicable
- vi) Statement giving list of important raw materials/components, list of sub-suppliers, list of standards according to which the raw materials are tested.
- viii) List of manufacturing facilities available.
- ix) Level of automation achieved and list of areas where manual process exists.
- x) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.
- xi) Lists of testing equipment available with the bidder for final testing of equipment specified and test plant limitation if any, vis-à-vis the type, special acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in schedule of deviations from specified test requirements.

6.2. The vendor shall also submit following information after award of contract :

- i) Sub-suppliers of raw materials as well as bought out accessories & components shall be selected from those furnished along with offers.
- ii) Type test certificates of the raw materials and bought out accessories as required by the utility.
- iii) Manufacturing Quality Plan (MQP) shall be submitted. The purchaser hold points for stage inspection shall be discussed between the purchaser and vendor at the time of award of contract before the MQP is finalized.

6.3. Makes of the following components (not restricted to) shall be subject to owner's approval.

- i) Relays
- ii) Instruments
- iii) SCR/IGBT
- iv) Diodes

v) Annunciator

7. TESTS

Battery chargers including the components shall confirm to all type tests including heat run test as per relevant Indian standards. Performance test on the chargers as per specification shall also be carried out on each charger.

7.1. Type Tests

7.1.1. Following type tests should have been carried out on each rating and type of Battery Charger for which reports are to be submitted.

- i. Complete physical examination.
- ii. Temperature rise test at full load (at highest voltage & highest current).
- iii. Insulation resistance test.
- iv. High voltage (power frequency) test on power and control circuits except low voltage electronic circuits.
- v. Ripple content test at
 - vi. No load
 - vii. Half load
 - viii. Full load
- ix. Automatic voltage regulator operation test at specified A.C. supply variations at
 - a) No load
 - b) Half load
 - c) Full load
- x. Load limiter operation test
- xi. Efficiency and power factor measurement.

a) **Environmental Tests**

Steady state performance tests (clause 4.01.00 (f) and (g)) shall be carried out before and after each of the following tests.

i) Soak Test

All electronic modules shall be subjected to continuous operation for a minimum period of 72 hours. During last 48 hours, the ambient temperature shall be maintained at 50 deg. C. The 48 hour test period shall be divided into four equal 12 hour segments. The input voltage during each 12 hours shall be nominal voltage for 11 hours followed by 110% of nominal voltage for 30 minutes, followed by 90% of nominal voltage for 30 minutes. The manufacturer shall submit the record of carrying out this test to the owner's engineer at the time of inspection.

ii) Degree of protection test (IP-42).

xii. Rectifier transformer – As per IS 4540.

7.1.2. If type tests are carried out against the contract, minimum 15 days notice shall be given by the contractor. The contractor shall obtain the owner's approval for the type test procedure before conducting the type test. The type test procedure shall clearly

specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type tests to be carried out.

7.1.3. In case the contractor has carried out the type tests within last five years as on the date of bid opening, he may submit the type test reports from NABL accredited laboratory to the owner for waiver of conductance of such type tests. These reports should be for the tests conducted on the equipment with identical design to that proposed to be supplied under this contract. The owner reserves the right for conducting any or all of the specified type tests under this contract.

7.2. Routine Tests

7.2.1. Following routine tests shall be carried out on all Rectifier transformers in addition to tests required as per IS-4540.

- a) Insulation resistance test.
- b) High voltage (power frequency) test.

7.2.2. Following routine tests shall be carried out on all Battery Chargers in addition to tests required as per IS-4540 :

- a) Complete physical examination.
- b) Short circuit test at full load and at no load for sustained short circuit of 10 sec (min. shall be carried out). The charger shall not trip, no fuse shall blow and charger current shall be limited to 150% of the rated current.
- c) Insulation resistance test.
- d) High voltage (power frequency) test.
- e) Ripple content test at
 - i) No load
 - ii) Half load
 - iii) Full load
- f) Automatic voltage regulator operation test at specified A.C. supply variations at
 - i) No load
 - ii) Half load
 - iii) Full load
- g) Load limiter operation test
- h) Checking of proper operation of annunciation system.
- i) Dynamic response test Overshoot/Undershoot in out put voltage of the charger as a result of sudden change in load from 100% to 20 % and 20% to 100% shall be measured.
- j) Soak Test (as per cl 4.01.00-1-j) - shall be carried out on all electrical modules/panels as routine test.
- k) The charger shall be checked for gasketing arrangement as per drawing.

7.2.3. Following routine tests shall be carried out on annunciation system.

- a) Burn in test shall be carried out as per Cl. 4.02.02 (j).

7.3. ACCEPTANCE TESTS:

7.3.1. Following acceptance tests and checks shall be carried out by the owner at the manufacturer's works:

- a) Complete physical examination.
- b) Checking of proper operation of annunciation system.
- c) Temperature rise test at full load.
- d) Insulation resistance test.
- e) Automatic voltage regulator operation.
- f) Load limiter operation.
- g) Dynamic response test.
- h) Ripple content test

7.3.2. Overshoot/Undershoot in output voltage of the Charger as a result of sudden change in load from 100% to 20% and 20% to 100% shall be measured with the Batteries connected/disconnected. Output voltage of the Charger connected with Battery shall be within 90 % to 110 % of the voltage setting in above conditions and shall return to, and remain, within the limits specified in clause 2.01.00 (e) in less than 2 seconds (as applicable).

7.3.3. The Contractor shall furnish for inspection, the type and routine tests certificates for Chokes and transformer whenever required by the Employer.

8. GUARANTEE

The battery charger shall be guaranteed for a period of 24 months from the date of commissioning.