

## SECTION-VIII

### POWER HOUSE AUXILIARIES

Power house auxiliaries shall consist of the following systems :

1	Batteries, Charging Equipment and D.C. Board	- 1 Lot
2	Grounding / Earthing	- 1 Lot
3	Lightning Protection	- 1 Lot
4	Fire Protection System for Power House	- 1 Lot
5	Lighting System	- 1 Lot

#### **8.1 BATTERIES, CHARGING EQUIPMENT AND D.C. BOARD ETC.**

##### **8.1.1 GENERAL**

8.1.1.1 This specification broadly covers manufacture, supply, installation and commissioning of (a) one set 48 volts, 300 AH capacity **NICKEL CADMIUM** batteries (b) one set of float and boost charger for quick and trickle charging of the batteries and for supplying 30 Amps continuous DC load and (C) one no. 48 volts D.C. distribution board.

8.1.1.2 The 48 volts 300 AH **NICKEL CADMIUM** high discharge type batteries shall be used for supplying power to essential services where instant availability and reliability of D.C. supply are most important such as:

Protection, control and indicating circuits.

D.C. emergency lighting of powerhouse.

Tripping and closing coils of 33 kV and 415 volts switchgears.

Trip coils for controlling generator field circuit breakers, emergency solenoid of electro hydraulic governor cubicle and alarm annunciator etc.

8.1.1.3 The battery and charger shall meet following load requirement:

Continuous load for three hours	30 Amps
Emergency load for one hour	25 Amps
Intermittent load for 1/60 hour	55 Amps

**The above load requirement is tentative. The tenderer shall give actual load requirement based on specification of the equipments offered.**

**8.1.1.4** The charging arrangement for main batteries shall comprise installation of one sets of float and boost battery charger. The boost charger should be capable of quick charging the battery in 10 hrs. from the fully discharged condition. The charger shall be connected to the batteries through D.C. distribution board, which shall have a charger load bus, load bus, emergency load bus contactors, MCCBs, and MCBs. By means of MCCBs, it shall be possible to connect any of the charger or Battery to the load bus. Under normal operating conditions, battery charger shall be connected to load bus, float charger shall be ON while boost charger shall be OFF, to keep the battery floating.

**8.1.1.5** The float charger shall be capable to trickle charge the 300 AH batteries at 1.3 volt/cell, while supplying a permanent load of 30 Amps. Boost charger shall be capable of quick charging the batteries upto 1.7 volt/cell. The charger shall be provided with controls for adjusting the voltage between range of 48 volts to 70 volt, so as to make them suitable for trickle charge as well as boost charge duty. For distribution of 48 volts D.C. supply, a 48 volts D.C. distribution board shall be installed with two incoming circuits from chargers one circuits from batteries and 12 outgoing circuits. One outgoing circuits shall feed the emergency lighting board, through emergency lighting contactors. The emergency lighting contactor shall supervise the A.C. supply to normal lighting boards and shall switch on D.C. lighting in the event of A.C. failure.

## **8.1.2 REQUIREMENT**

One no. 48 volts, 300 AH nickel cadmium batteries complete with stands, insulators, inter-row, inter-tier and inter-cell connectors.

One set of automatic voltage regulated, static type full wave battery charger for batteries complete with filters, rectifier, AVR, voltmeter (0-100 V DC), ammeter 0-100 Amps, moulded case circuit breaker, fuses etc.

One no. 48 volts D.C. distribution board equipped with:

One positive and one neutral charger load bus.

One positive and one neutral for load bus

One positive and one neutral for emergency load bus

One outgoing circuit controlled by MCCB from the charger load bus connecting load bus.

Three incoming circuits of moulded case circuit breaker type, two from battery charger and one from battery.

Outgoing circuits of miniature circuit breaker type, one of which shall feed emergency lighting board through emergency lighting contactors and remaining to the other D.C. loads.

The D.C. distribution board shall be equipped with protective relays to give visible and audible alarms with buzzer silencing facility etc. under the following conditions:

Over voltage at bus bar

Under voltage at bus bar

Battery ground (positive bus, negative bus)

A.C. supply failure annunciation

D.C. over load

Earth leakage

Float output D.C. fuse failure/MCCB trip

Boost output D.C. fuse failure/MCCB trip

Controller card defective

Float charger failure

Boost charger failure

Alarm annunciation scheme for the above protections with "Alarm accept, reset and test push buttons."

One No. 415V/230V A.C. emergency lighting contactor.

Instrument for measuring

Voltage for 415V A.C. supply

D.C. output voltage of float and boost charger

D.C. output current of float and boost charger

Trickle charging current of battery and discharging current from battery

Four outgoing circuit of miniature circuit breaker type from emergency load bus.

An internal lamp with a door switch shall be provided. The distribution panel shall be physically matching with the charger panel in all respect and its construction will be similar to the charger cubicles.

### **8.1.3 TECHNICAL PARTICULARS**

#### **8.1.3.1 Battery**

Type	Nickel cadmium
Normal voltage of a single cell	1.2 volt
Capacity when discharging to 1.0 volts/cell at 10 hrs discharge rate	300 AH
Voltage under floating conditions	52 Volts
Voltage at the end of full discharge	45 Volts
No. of cells	40 Nos.
Types of cells (to comply IS:10918-1984)	Open type, single cell construction

The nickle cadmium batteries shall comply with IS 10918-1984 or its latest version.

#### **8.1.3.2 Connectors**

48 V battery cells shall be accommodated in double row single tier arrangement on wooden stands. Sufficient No. of inter-row, inter-tier and inter-cell connectors shall be provided.

#### **8.1.3.3 Potassium Hydroxide**

It shall strictly comply with relevant ISS and shall be sufficient for one filling with 10% spare.

#### **8.1.3.4 Water**

The distilled water shall be sufficient for one filling and charge-discharge-recharge operations with 10% spare. It shall conform to IS:1069-1964 (revised).

### **8.1.3.5 Stand**

The stand shall be constructed from seasoned teak wood and shall be robust enough to take the full load of batteries. The stand shall have bolted connections and should be supplied in pieces to facilitate entry in the battery room. The stands shall be coated with three coats of paints as per IS requirements.

### **8.1.3.6 Bolts & Nuts**

Bolts and nuts for connecting the cells shall be effectively lead coated to prevent corrosion.

## **8.1.4 Float & Boost Charger For 48 V Battery**

### **8.1.4.1 Type**

It shall be static type, full wave, suitable for boost charging and trickle charging to keep 40 cells battery floating under normal operating conditions while supplying permanent load upto 30 Amps.

Input	-	415 V, 50 c/s, 3 phase A.C.
Output	-	48 V to 70 V
Current	-	30 Amps permanent load

In the event of failure of float charger, boost charger should be capable to boost/trickle charge the batteries and also to supply 30 Amps. permanent load.

### **8.1.4.2 Regulation**

It shall be inherently voltage regulated static type with automatic regulation within plus and minus one percent from 10% of rated load to full load and shall have steep voltage drop beyond 110% full load.

Both the chargers will be housed in a sheet steel cubicle of angle iron structure with adequate ventilation for natural air cooling, suitable for floor mounting indoor operation and having door at the rear side with locking arrangement for easy access to all the components housed in side as detailed below. The height of the charger shall be such as to allow easy operation of all the switches and push buttons.

## **8.1.5 48 Volts D.C. Distribution Board:**

### **8.1.5.1 D.C. Bus Bars:**

There shall be one charger load bus, one load bus and one emergency load bus. The charger load bus shall be rated for 200 Amp, 10kA short circuit withstand rating. Load bus bar shall be rated for 100 Amps, 10 kA short circuits withstand rating. The emergency load bus shall be rated for 50 Amps, 5 kA short circuits withstand rating. The charger load bus and load bus shall be connected through 100A MCCB.

### 8.1.5.2 Outgoing Circuits: (20 Nos.)

- 4 Nos. feeder to 2 nos. UCBs .
- 1 No. feeder to control and relay panel.
- 1 No. feeder to L.T. Board.
- 1 No. feeder for 33 kV switchyard
- 4 Nos. feeders to Electronic governor panel
- 4 Nos. feeder to excitation panel
- 5 Nos. feeders as spare.

One No. feeder for emergency lighting which will comprise of a emergency load bus and 4 Nos. outgoing emergency light circuits having 16 amps MCB in each circuit, each housed in D.C. panel itself. One main lighting feeder shall be connected to emergency load bus through emergency lighting contactors. The contactor will normally keep D.C. supply to the mini bus off, but in case A.C. fails it will automatically switch on the D.C. to emergency lighting.

**Note:** All above feeders except emergency load bus feeder will be connected through 32 amps MCB. Emergency load bus will be connected through 50 Amps MCCB.

8.1.5.3. One no emergency lighting contactor rated for 415/230 V. A.C. and provided with two sets of contacts controlling D.C. emergency contactor. The DC contactor rated for 48 Volt. controls D.C. emergency supply.

8.1.5.4 The board shall be complete with wiring, cable glands, cable lugs for termination of outgoing and incoming circuits, as shown in drawing. This drawing is tentative and tenderer is desired to submit his own drawing for approval of the purchaser.

### 8.1.6 Instruments

Following instruments may be installed on the charger:

1. AC voltmeter 0-500 V with RY, YB, BR selector switch
2. DC output-voltmeter for float charger
3. DC output-voltmeter for boost charger
4. DC ammeter for float output
5. DC ammeter for boost output
6. DC ammeter (centre zero) to measure trickle charging current to battery as well as discharging current from the battery.

### 8.1.7 Spares

The technical particulars of the spares shall be identical to those of corresponding components. Tenderer will give list of spares required for five years.

### 8.1.8 Tools

#### For 48 volt 300 AH Nickel Cadmium Battery

Cell testing voltmeter	2 Nos.
Thermometers	2 Nos.
Hydrometers	2 Nos.

Alkaline mixing tank	1 No.
Alkaline resistant jugs, funnels, rubber apron, rubber gloves, rubber siphon and rubber syringes, spanners	2 Nos. each

### **8.1.9 Design & Construction**

8.1.9.1 Wooden stands shall be of first class seasoned teakwood. These shall be mechanically strong and coated with three coats of KOH resistant paint.

8.1.9.2 Charger shall be floor-mounting type totally enclosed in steel cabinet with provision of cable entry from bottom. All the breaker controls and instruments shall be mounted in front of the panel and at a convenient height to facilitate ease of operation. It shall be provided with hinged doors at the rear side. The charger cabinet shall be painted with approved shade colour as per ISS Plastic paint in gloss finish shall be used.

8.1.9.3 DC distribution board shall be floor-mounting type. It shall be totally enclosed in steel cabinet with welded steel work inside so as to make it rugged and all fuses bus bars and switches except their operating handle shall be mounted inside. Bus bars shall be covered with coloured PVC tapes or epoxy insulated and shall be designed for the appropriate current rating. A common earthing shall be provided for the DC board. Cable glands shall be provided and mounted on the glands plate so as to facilitate easy termination of all the incoming and outgoing cables entering from the bottom. Front of the cabinet shall be hinged type. The cabinet shall be painted with approved shade colour.

### **8.1.10 Tests**

Following tests shall be performed on each battery after installation at site. The tests shall be performed in accordance with IS:1651-1970 and the test results shall strictly conform to the provisions of the above said standard.

Visual inspection and dimensional check as per Para 8.1 of IS:1651-1970.

Capacity test on complete batteries as per Para 10.5 of IS:1651-1970.

Test for retention of charger as per Para 10.2 of IS:1651-1970.

Potassium hydroxide supplied shall be tested in accordance with IS (revised).

### **Tests of Chargers**

Following tests shall be performed on each of the charger:

General inspection of circuits, associated components and checking of wire etc.

Capacity test on charger to verify temperature rise of various components.

Calibration test of indication instruments.

Performance test on voltage regulating equipment both on auto and manual condition.

Testing of overload and other protective devices.

### **Tests on DC Distribution Board**

General inspection of the board and associated components checking of working etc.

Calibration test of indicating instruments provided on the D.C. distribution board.

Test of insulation resistance.

Test of safety devices such as over voltage, under voltage and ground fault alarms and lighting contactors etc.

## 8.2 GROUNDING / EARTHING

Earthing system shall be designed as per IS: 3043 and IEEE: 80. Earthing system network/earthmat shall be interconnected mesh of mild steel rods buried in ground in the plant. All off-site areas shall be interconnected together by minimum two parallel conductors. The contractor shall furnish the detailed design and calculations for Owner's approval. Contractor shall obtain all necessary statutory approvals for the system.

Soil resistivity data for by shall be measured by the Contractor for designing earthing system.

Enclosures of all electrical equipment as well as all cabinets/boxes/panels/etc. shall be earthed by two separate and distinct earth connections. Metallic pipes, conduits, cable tray section, etc. shall be bonded to ensure electrical continuity and earthed at regular intervals as well as at both ends. Metallic conduits, pipes, etc. shall not be used as earth continuity conductor. All hinged doors shall be earthed by flexible braids of adequate size.

All steel structures shall be duly earthed. Metallic sheaths and armour of all multicore cables shall also be earthed at both equipment and switchgear end.

Earthing conductor shall be buried at least 2000 mm outside the fence of electrical installations. Every alternate post of the fences and all gates shall be connected to earthing grid by one lead. Earthing conductor embedded in the concrete floor shall have at least 50 mm concrete cover.

Earthing connections with equipment earthing pads shall be bolted type with at least two bolts, and joint surfaces shall be galvanised. The connections shall be painted with anti-corrosive paint after testing and checking.

Neutral of power transformers shall be directly connected to two rod electrodes in treated earth pits, which in turn shall be connected to station earthing grid.

The earthing terminal of surge arresters and voltage transformers, and lightning protection, down conductors shall also be connected to station earthing grid through separate rod electrode.

The earthing resistance of the grounding system of the power house and the switchyard together shall not be more than 0.5 Ohms.

### Other requirements for Earthing system

a.	Standard/Code	IEEE-80, IS: 2309
b.	Earthing system life expectancy	40 years
c.	System fault level	40 kA for one second
d.	Soil resistivity	Contractor to measure at site at min. 20 locations approved by Owner.
e.	Min. steel corrosion rate	0.25 mm per year.
f.	Depth of burial of main earth conductor	600 mm below ground level; where it crosses conductor trenches, pipes, ducts tunnels, rail tracks, etc., it shall be at least 300 mm below them.

- g. Conductor joints By electric arc welding, with resistance of joint not less than that of the conductor. Welds to be treated with red lead for rust protection and then coated with bitumen compound for corrosion protection.
- h. The minimum conductor size for earthing system shall be as follows:

Equipment	Buried conductor	Conductor above ground & in trenches
Main station grid	40 mm dia MS rod	65x8 mm GS flat
Switchgear	--	65x8 mm GS flat
415 V distribution boards	--	50x6 mm GS flat
HT motors	--	50x6 mm GS flat
LT motors above 125 kW	--	50x6 mm GS flat
LT motors - 25 to 125 kW	--	25x6 mm GS flat
LT motors - 1 to 25 kW	--	25x3 mm GS flat
Fractional HP LT motors	--	8 SWG GS wire
Control panel & control desk	--	25x3 mm GS flat
Push button stn. & Junction box	--	8 SWG GS wire
Cable trays, cols. & structures	--	50x6 mm GS flat
	--	50x6 mm GS flat
Rails & other metal parts	--	25x6 mm GS flat
Equipment earthing for switchyard	--	76x8 mm GS flat and 50x6 mm GS flat

### 8.3 LIGHTNING PROTECTION

The lightning protection system shall be designed as per IS: 2309. It shall cover all buildings and structures in the plant, and switchyard areas. It shall comprise horizontal/vertical air terminations, down conductors, test links and earth connections to the station earthing grid. All conductors shall be of minimum 25x6 mm size and shall be of galvanised steel only.

The down conductors of lightning protection system shall have a test joint at about 1500 mm above ground level. Each down conductor shall be connected to a 40 mm dia, 3 m long mild steel earth electrode as well as station earthing grid.

The lightning protection system shall not be in direct contact with under ground metallic service ducts and cables, and shall not be connected above ground level to other earthing conductors. All joints in the down conductors shall be of welded type.

Pulser system for lightning shall not be accepted.

Hazardous areas handling inflammable/explosive materials and associated storage areas shall be protected by a system of aerial earths as per IEEE: 142.

## 8.4 Fire Protection Equipment / System For The Power House

Fire fighting arrangements at the generator floor, control room, switchgear room etc. of the power house shall be provided. The equipment/system shall comprise fire/smoke detectors, portable fire extinguishers, fire buckets and hydrants as per the IS/relevant standards.

### i. Portable Fire Extinguishers

Portable Fire Extinguishers of various types of requisite capacity shall be located at appropriate locations in the power house as below:

- |    |   |   |  |
|----|---|---|--|
| a. | Trolley mounted CO <sub>2</sub> type    | : | 2 cylinders on Generator floor               |
| b. | CO <sub>2</sub> type fire extinguishers | : | 2 Nos. for Control room                      |
| c. | Soda Acide type                         | : | 2 Nos. Near D.C. batteries                   |
| d. | Foam type extinguishers                 | : | 2 Nos. Near OPU                              |
| e. | Dry chemical type extinguishers         | : | 2 Nos. for Switchgear and Control room each  |
| f. | Carbon Tetra-Chloride type              | : | 5 Nos. for General electrical installations, |

### ii. Fire Buckets

**Two sets of fire buckets, each set comprising 6 buckets filled with sand, shall be provided on covered steel stand at various places in the powerhouse area.**

## 8.5 Lighting System

### 8.5.1 Scope

These specification covers design, manufacture, supply, installation, testing and commissioning of the lighting system at the project. The scope covers lighting arrangement for powerhouse, switchyard, tailrace, forebay and other appurtenant works like bye pass approach road and trash rack etc.

### 8.5.2 Standards

IS: 3646	Illumination and glass index
IS: 694	Wires
IS: 732	Wiring installation conditions

### 8.5.3 General Requirements

A comprehensive illumination system shall be provided in the entire project i.e. all areas within the plant boundary. The system shall include lighting fixtures, distribution boards, lighting panels, junction boxes, lighting poles, receptacles, switchboards, cables and wires, conduits, poles and masts, etc. The system shall cover all interior and exterior lighting such as area lighting, yard lighting, street lighting, security lighting, etc.

### 8.5.4 Design Criterion

The illumination system shall be designed on basis of best engineering practice and shall ensure uniform, reliable, aesthetically pleasing, glare free illumination. The design shall prevent glare/luminous patch seen on VDU screens, when viewed from an angle.

Power supply shall be fed from 415/240 V normal ac power supply, station service board, and 48 V dc supply for emergency lighting. Lighting panels shall be located at different convenient locations for feeding various circuits. These panels shall be robust in construction with lockable arrangements and MCB for different circuits.

48V dc emergency lighting shall be provided in following areas:

- |    |   |                   |
|----|---|-------------------|
| a. | Machine hall  | 20 lux            |
| b. | Control room  | 100 lux           |
| c. | Exit points and stair cases   | One light fixture |
| d. | All other strategic locations for safe personnel movement during any emergency. |                   |

DC lighting shall come on automatically on failure of normal ac supply. These shall be switched off automatically after the normal ac supply is restored and luminaries have attained their full glow.

Lighting panels, fixtures, receptacles, poles, masts, distribution boards, switch boxes, conduits, junction boxes etc. shall be properly installed and earthed.

All outdoor fixtures shall be weather proof type. Fluorescent fixtures, installed in other than control room areas shall have electronic ballasts. For control rooms, the ballasts shall be copper wound inductive, heavy duty type, filled with thermo-setting insulating moisture repellent polyester.

All luminaries and their accessories and components shall be of the type readily replaceable by the available Indian makes. All fixtures and accessories shall be of reputed make and non-corrosive type. Acrylic covers/louvers shall be of non-yellowing type.

The constructional features of lighting distribution boards shall be similar to AC/DC distribution boards described elsewhere. Outgoing circuits shall be provided with MCBs of adequate ratings.

Wiring shall be by multi-stranded PVC insulated colour code cable laid in GI conduits. Wiring for lighting circuits of ac, and dc systems shall be run in separate conduits throughout. Minimum size of the wire shall not be less than 1.5 sq.mm copper or 4 sq.mm aluminium. Wire shall conform to IS: 694 and wiring installation shall be as per IS: 732.

Conduits shall be of heavy duty type, hot dip galvanised steel conforming to IS: 9537. In corrosive areas, conduits shall have additional suitable epoxy coating.

At least one 5/15A, 240 V universal socket outlet shall be provided in offices, stores, cabins, control room, switch gear room etc. 20A, 240 V ac industrial type receptacles shall be provided strategically in all other areas including switch gear room and control room. All these receptacles shall be 3 pin type and controlled with a switch. Suitable numbers of 63 A, 3 phase, 415 V ac industrial type receptacles with control switches shall be provided for the entire plant

for welding and other purposes, particularly near all major equipment and at an average distance of 50 m.

Street lighting shall be with swaged tubular steel poles of swan new construction. The poles shall be coated with anti-corrosive treatment and paint.

Area lighting shall be with suitable lighting masts. Masts of adequate height shall have lattice structure with ladder, cage and top platform. Alternatively they shall have lantern carriage of raise/lower type with electrical winch provided inside the tubular mast.

All outdoor lighting systems shall be automatically controlled by synchronous timer or photocell. Arrangement shall be provided in the panel to bypass the timer/photocell for manual control.

### 8.5.5 Illumination Levels And Type of Fixtures And Luminaries

Location	Average Illumination level (Lux)	Type of Fixture
Machine Hall	200	HPSV high/medium bay Industrial trough type fluorescent
Control room	300	Decorative mirror optics
Offices	300	type -Do-
Switchyard	10 (general) 50 (on equip.)	HPSV flood light, weather proof
Street lighting roads	20	HPSV street lights
Outdoor storage handling	20	HPSV flood light, weather proof.
Garage/Car parking	70	Industrial trough type fluorescent