

SECTION- IX

POWER HOUSE AUXILIARIES

Power house auxiliaries shall consist of the following systems :

- | | | |
|---|---|---------|
| 1 | Batteries, Charging Equipment and D.C. Board | - 1 Lot |
| 2 | Power & Control Cables Including Cable Trays | - 1 Lot |
| 3 | Fire Protection System for Power House | - 1 Lot |
| 4 | Lighting in Power House, switchyard & appurtenant works | - 1 Lot |

9.1 BATTERIES, CHARGING EQUIPMENT AND D.C. BOARD ETC.

9.1.1 GENERAL

9.1.1.1 This specification broadly covers manufacture, supply, installation and commissioning of (a) one set 24 volts, 150 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. 24 volts D.C. distribution board.

9.1.1.2 The 24 volts 150 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:

9.1.1.3 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.

9.1.1.4 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.

9.1.1.5 The float charger shall be capable to trickle charge the 150 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 24 volts D.C. supply, a 24 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.

9.1.2 REQUIREMENT

- i) One no. 24 volts, 150 AH nickel cadmium batteries complete with stands, insulators, inter-row, inter-tier and inter-cell connectors.
- i) 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.
- ii) One no. 24 volts D.C. distribution board equipped with:
 - i) One positive and one neutral charger load bus.
 - ii) One positive and one neutral for load bus
 - iii) One positive and one neutral for emergency load bus
 - iv) One outgoing circuit controlled by MCCB from the charger load bus connecting load bus.
 - v) Three incoming circuits of moulded case circuit breaker type, two from battery charger and one from battery.
 - vi) 12 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.
 - vii) 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:
 - i) Over voltage at bus bar
 - ii) Under voltage at bus bar
 - iii) Battery ground (positive bus, negative bus)
 - iv) A.C. supply failure annunciation
 - v) D.C. over load
 - vi) Earth leakage
 - vii) Float output D.C. fuse failure/MCCB trip
 - viii) Boost output D.C. fuse failure/MCCB trip
 - ix) Controller card defective
 - x) Float charger failure
 - xi) Boost charger failure
 - xii) Alarm annunciation scheme for the above protections with "Alarm accept, reset and test push buttons."
- viii) One No. 415V/230V A.C. emergency lighting contactor.
- ix) Instrument for measuring
 - i) Voltage for 415V A.C. supply
 - ii) D.C. output voltage of float and boost charger
 - iii) D.C. output current of float and boost charger
 - iv) Trickle charging current of battery and discharging current from battery
 - x) Four outgoing circuit of miniature circuit breaker type from emergency load bus.

- xi) 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.

9.1.3 TECHNICAL PARTICULARS

9.1.3.1 Connectors

24 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.

9.1.3.2 Potassium Hydroxide

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

9.1.3.3 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).

9.1.3.4 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.

9.1.3.5 Bolts & Nuts

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

9.1.4 Float & Boost Charger For 24 V Battery

9.1.4.1 Type

It shall be static type, full wave, suitable for boost charging and trickle charging to keep 20 cells battery floating under normal operating conditions while supplying permanent load upto 30 Amps.

1.	Type of Rectifier	1 PH, SCR controlled
2.	No. of Units	Separate Boost and Float Charger
3.	Manufacture type and designation and standard applicable	Any reputed brand as per relevant IS specification
4.	A.C. Supply required	1600 VA

5.	Percentage taps provided on the transformer	+ / - 5 % + / - 10 %
6.	Rated D.C. output for	
a)	Boost Charger	15 A
b)	Float Charger	15 A
7.	Rated DC output Voltage for	
a)	Boost Charger	27 V max.
b)	Float Charger	26 V max.
8.	Range of DC voltage control for	
a)	Boost Charger	27 V max.
b)	Float Charger	26 V max.
9.	D.C. output voltage regulation from no load to full load	+ / - 1 %
10.	Maximum ripple current	+ / - 3 %
11.	Overall efficiency	70 %
12.	Unit dimension	1200 (L) x 550 (D) x 1500 (H)
13.	List of major accessories of spares	Please refer Bill of material
14.	Constructional details	14/16 SWG CR sheets

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.

9.1.4.2 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.

9.1.5 24 Volts D.C. Distribution Board:

9.1.5.1D.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.

9.1.5.2Outgoing Circuits: (12 Nos.)

- i) 1 No. feeder to control and relay panel.
- ii) 1 No. feeder to L.T. Board.

E.E. (E-M),
0/0 the CE, DHPD, Itanagar

- iii) 1 No. feeder for 11 kV switchyard
- iv) 3 Nos. feeders to Electronic governor panel
- v) 3 Nos. feeder to excitation panel
- vi) Two 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.

9.1.5.3. 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 24 Volt. controls D.C. emergency supply.

9.1.5.4 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.

9.1.6 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.

9.1.7 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.

9.1.8 Tools

For 24 volt 150 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

E.E. (E-M),
0/0 the CE, DHPD, Itanagar

9.1.9 Design & Construction

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

9.1.9.2 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.

9.1.9.3 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 ear thing 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.

9.1.10 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.

- i) Visual inspection and dimensional check as per Para 10.4 of IS:1651-1970.
- ii) Capacity test on complete batteries as per Para 10.5 of IS:1651-1970.
- iii) Test for retention of charger as per Para 10.7 of IS:1651-1970.
- iv) Potassium hydroxide supplied shall be tested in accordance with IS (revised).

Tests of Chargers

Following tests shall be performed on each of the charger:

- i) General inspection of circuits, associated components and checking of wire etc.
- ii) Capacity test on charger to verify temperature rise of various components.
- iii) Calibration test of indication instruments.
- iv) Performance test on voltage regulating equipment both on auto and manual condition.
- v) Testing of overload and other protective devices.

Tests on DC Distribution Board

- General inspection of the board and associated components checking of working etc.
- i) Calibration test of indicating instruments provided on the D.C. distribution board.
 - ii) Test of insulation resistance.

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

9.2 POWER & CONTROL CABLES INCLUDING CABLE TRAYS

9.2.1 Scope

The scope shall include supply, laying of power and control cable, cable trays, termination of cable etc., their testing and commissioning as per requirement.

9.2.1.1 Power Cables

The 1100 volts grade power cables in full length (Without Intermediate Joints) shall be required to interconnect the .415 V stator terminals to .415 V switchgear located in the power house and to terminal cubicles. Continuous current carrying capacity may be calculated as per actual and got approved by the Engineer-in-Charge.

- i. 415 V Switch gear to 415 V terminal of .415 V /11 kV Main Generator Transformers located in the switchyard for any other necessity in the power station as required.
- ii. L.T. Power Cables

The 415 V AC and 24 V DC cables shall be required to interconnect the different auxiliary service boards and connect to various equipment to various distribution boards as required. 250 V DC flexible insulated oil restraint copper cable shall also be required to connect generator field with the excitation equipment. The insulation level of all these cables shall be 1.1 kV grade.

9.2.1.2 Control, and Instrumentation Cables

These shall include all cables required for the installation of the complete instrumentation, control, protection and metering systems in the power house, transformer sub-station, switchyard, diesel set and fore bay.

Special reference is made to:

- i. Control room with their control panels/control desks, metering, protection and automatic control cubicles.
- ii. The digital turbine governor electronic/mechanical cabinets, the static excitation equipment alongwith automatic voltage regulators.
- iii. Automatic and manual control of unit
- iv. Unit and station auxiliaries

9.2.1.3 Cable Trays, Supporting Structures, Cables Terminals etc.

The cable trays, supporting structures, cable terminating lugs and other accessories shall be required to interconnect various service boards and equipment to complete the system.

9.2.1.4 Design Features

All cables shall be designed to cope with the short circuit conditions and voltage drop. Fusing capacity of power cables may be taken for fault duration of 200-ms. Maximum short circuit current for 415V power circuit as 18 kA. For PT & CT circuits, 4 mm² copper cables shall invariably be used. DC distribution shall also be on 6mm² copper cables. Size of aluminium power cable shall in no case be less than 10 mm².

The cables shall be capable of satisfactory operation under a power supply system voltage variation of $\pm 10\%$ and frequency variation of $\pm 5\%$ and a combined frequency voltage variation of 10% (absolute sum). The cables shall have heat and moisture resistant properties. These shall be of type and design with proven record of power station installation.

All the accessories and special tools supplied and used by the contractor during the installation of cables shall be handed over to the Owner for future use after completion of work.

Broad assessment/quantities of different type of power and control cables, no. of cores, ratings, sizes, fault current withstand capability etc. shall be furnished with the bid.

Quantities of different sizes of cable trays, supporting structures, cable routes, cable schedules termination detail etc. shall also be furnished.

For the purpose of proper assessment of the requirement, the site may be visited on any working day with prior intimation.

9.2.1.5 Power Cables 1100 Volts Grade

All LT power cables shall be of stranded Aluminium conductor except DC power cables, which shall be of stranded copper conductor. All control and instrumentation cables shall be of stranded 2.5 mm² copper conductors except cables for CTs & PTs which shall be 4 mm².

Single Core Cables

These cables shall be at least 1100 volts grade, heavy duty, single core, stranded aluminium / **copper** conductor, HR-PVC insulated and PVC sheathed armoured FRLS type and shall conform to the same design and properties as cables conforming to IS: 1554 (Part I & II) / IEC. The outer sheath is of specially formulated PVC compound.

Multi-core Cables

The cable shall be at least 1100 volts grade, heavy duty multi-core, stranded aluminium/copper conductor, PVC insulated, colour coded, laid up, armoured inner sheathed with extruded PVC, 2/3.5 or multi-cores FRLS type, conforming to IS 1554 / relevant IEC. (Part I). The outer sheath is of specially formulated PVC compound.

Control & Instrumentation Cables

The control & instrumentation cables shall be multi-core, colour coded, annealed high conductivity copper, single conductor, insulated with HR-PVC insulation, PVC sheathed, armoured FRLS type conforming to IS 1554 (Part I & II) / relevant IEC. The outer sheath is of specially formulated PVC compound,

All these cables shall have the following properties:

Oxygen index	Min. 29
Smoke density	Min. 40% light transmittance
Acid gas	Max. 20% by weight
Flame propagation	Shall meet IEC 332-1, IEEE 383 & SEN of 4241475 (Class F 3)

9.2.1.6 Performance Criteria and Guarantees

The power, control and instrumentation and other cables system shall be capable of performing all intended duties and it is the responsibility to supply the equipment as per guaranteed technical particulars.

9.2.2 DESIGN AND CONSTRUCTION

9.2.2.1 Conductor

The conductor shall be made from stranded annealed copper / aluminium to form compact conductor having a resistance within the limits specified in relevant IS /IEC. HR-PVC insulated cable of size 25mm² and above shall have sector shaped conductor.

9.2.2.2 Conductor Shield

The conductor having a semi-conducting screen shall ensure perfectly smooth profile and avoid stress concentration. The conductor screen shall be extruded in the same operation as the insulation. The semi-conducting polymer shall be cross-linked (for XLPE cables)

9.2.2.3 Insulation

The insulation of the cables shall be extruded type and shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation is free from voids.

The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method should give very smooth interface between semi-conducting screen and insulation. The insulation of the cable shall be of high standard quality.

9.2.2.4 Sheath

The sheath shall be suitable to withstand the site conditions and specified temperature conditions. It shall be of adequate thickness and applied by a continuous process to produce a sheath of consistent quality free from any defects. The sheath shall be extruded.

9.2.2.5 Armour

Hard drawn aluminium wire armouring /single galvanised steel tape/wire armouring shall be used for single core and multi-core cables respectively. The diameter of the aluminium wire shall be as per the table for the dimensions of the galvanised steel wire armour given in the relevant standard.

9.2.2.6 Service and Outer Sheath

Extruded PVC serving as specified shall be applied over armouring with suitable additives to prevent attack by rodents and termites. All servings must be given anti-termite treatment. The cable shall have suitable fillers laid up with the conductors, before the sheath is applied and the fillers shall be of substantially circular cross section. Fillers shall be suitable for operating temperature of the insulation and compatible with the insulation.

9.2.2.7 Size & Length of Cables

The number of cores and sizes of the cables required for various circuits shall be specified in the schedule of requirement by the contractor.

The cables covered by this specification shall be supplied in one length or in standard length as approved by the Owner.

9.2.2.8 Colour Scheme and Identification

To facilitate easy identification of phases a colour scheme of Red, yellow and Blue for phases and black for neutral shall be adopted for power cables. Multi-core control cables shall be colour coded for identification of cores as per IS: 1554 1976/ IEC.

All the cables shall carry manufacturer data in a permanent, legible manner at an interval of at least 3 meter run. The manufacturer's data shall include the name; cable size, voltage rating together with any other information.

9.2.2.9 Termination Kit

The termination kits required for 1100 Volts grade power cables terminations shall be heat shrinkable type as per relevant IS / IEC.

The contractor shall supply all hardware consumables such as plumbing metal, sealing compound, tapes and other materials required for the making of these terminal connections of various sizes of cables.

9.2.2.10 Cable Lugs

The cable lugs shall be supplied as per cable schedule and these shall be made of copper tube electro tinned. The contractor shall supply longneck-crimping lugs for cables of size 400 mm² & above. The contractor shall ensure that no bimetallic action takes place, between the aluminium conductor of the cable and the cable-connecting lug by filling the lugs with suitable compound. The lugs shall be of standard quality conforming to relevant IEC / IS only.

9.2.2.11 Cable Accessories

The contractor shall supply all the required accessories that may be found necessary during actual execution of the job, within the quoted prices.

9.2.2.12 Cable Glands

The cable glands shall be double compression type and shall be made of brass duly electro tinned in order to avoid corrosion and oxidation of the surface. The nipple threads shall be in accordance with IS 1653 / IEC. Glands shall provide neat, tight, dust and vermin proof termination.

Gland shall be provided with rubber ring to hold the cables firmly when check-nut is slightly tightened. Gland shall be complete with suitable washers etc.

9.2.2.13 Compression Type Terminals for Control Wiring

These terminals are required for copper conductor of control wiring. They shall be crimped to the conductor while other end will provide flat surface for better connections. The connectors shall be made of copper electro tinned.

9.2.2.14 Button Tape (Strap & Stud)

This consists of perforated cable strapping with holes conveniently spaced for assembly and moulded studs. The strapping shall be made of NYLON Grade 220 or other elastic material to give proper performance. The studs shall be made of 'NYLON'.

9.2.2.15 Self Adhesive Marker

Self-adhesive marker in the form of strips of any one character, which can be easily peeled from the backing cards and can be applied on the cable, shall be supplied. The strips shall be water- proof duly marked with special formulated ink with specific thermo-setting adhesive to withstand high temperature.

Suitable plastic ring type ferrules marked with engraved indelible ink for control cables and sticker type ferrules for power cables shall be supplied. These shall be marked as per cable schedule such that each core of each cable can be identified easily.

9.2.2.16 Aluminum Strip

Aluminium strip of adequate size for making tags for labels shall be supplied.

Good quality PVC tapes, cotton tapes and any other accessories required for laying, termination, testing & commissioning shall be supplied conforming to relevant IS.

9.2.3 Cable Trays & Support Structure

Perforated cable trays made out of 14-gauge mild steel sheet shall be fabricated. The trays shall be provided with long shape slots of 20mm x 8mm size. The trays shall be of perforated plates for proper ventilation of the cables.

The cable trays shall be fully galvanized as per the relevant IS / IEC and the Owner reserves the right to test galvanizing as specified in the relevant IS / IEC in presence of its representative. The tack welded portion of trays and the contact surfaces shall be given a layer of epoxy paint or shall be treated with galvanized compound. The cable support shall be painted.

Detailed design of the cable trays & supports shall be got approved from the Owner before commencement of fabrication/assembly. The fixing of supports to the walls/ceiling/tunnel/column/ trench etc. is also covered in the scope of supply. The fixing arrangement shall be approved by the Owner. Embedment for the fixing of the supports shall be provided by the Owner.

9.2.4 Fire Proofing

Cables passing through different fire zones, shall be provided with fire-proof barriers with the same fire rating as the penetrated walls or partitions.

9.2.5 Cable Junction Boxes

Junction box shall be constructed of sheet steel of thickness not less than 2mm. The door shall be adequately strengthened to ensure rigidity and strength. Sheet steel and sections used in enclosures shall be cut neatly and finished free from burrs. Ample wiring space shall be provided at the sides, and back of the enclosure for incoming and outgoing circuits. Removable plates with gaskets shall be fitted at the top and bottom of the box to provide the entry for conduit or cable. The door shall be suitably gasketed and fitted with a lock type handle. The door shall be hung on hinges having brass bodies and stainless steel pins.

Each cable junction box shall be provided with terminals of adequate rating on the terminal strip of suitable thickness. Disconnecting (sliding) type terminal blocks shall be provided, to facilitate testing & maintenance without disconnecting the cables.

Multi-block terminal board of 15 A, 500 V rating shall be provided to form assembly of number of terminal block. Assembly may be secured with only two screws on the surface. There shall be provision on the strips to add more terminal in case of further requirement.

9.2.6 Packing

All the cables shall be supplied on non-returnable wooden drums with adequate barrel diameter so as to avoid any damage to the cables and to withstand rough handling during transportation and storage.

Particulars of the drum on which the cables would be packed for transportation with a dimensioned drawing shall be submitted. Preferably not more than one length shall be wound on one drum. The supplier will be held responsible for any loss or damage caused by any defects in packing.

A layer of waterproof paper shall be applied to the surface of the drums and over the outer cable layer. A circular space of at least 40mm shall be left between the cable and the lagging. Each drum shall carry the name of the manufacturer, the name of the Owner his address, order number, item number, type, size length of cable, net and gross weight duly stencilled thereon.

9.2.7 Quality Control And Assurance Requirements

The supplier has to supply the cables and other accessories of best quality. The supplier has to maintain control and quality assurance during the manufacturing, installing, testing and commissioning of equipment. The quality assurance plan shall be submitted with the technical bid.

9.2.8 Calculations

The supplier is required to submit the calculation for selecting the cable size for connecting various boards/equipment. The cable schedule and termination diagram for all power, control & telephone cables shall be prepared by the contractor and submitted to Owner for approval.

9.2.9 Workshop Test

The cables shall be routine tested as per relevant IEC/IS at the works of supplier in presence of representative of the Owner. The Supplier is required to submit type test certificate and routine test reports of all the items.

Requirement of tests for power and control cables (IS 1554 / IEC).

9.2.10 Installation And Commissioning

All installation and lying of cables and cable trays shall be done by skilled workers in a workmanlike manner. Sufficient spare cores in control cables shall be kept as spare cores in cable scheduling for future use. Before charging of cables all wiring/cable shall be checked as per cable schedule programme.

i. Cable Routing

For the main cable ways, a system of cable racks and trays as well as cable ducts and trenches shall be provided. The cable trays shall be provided for power and control cables. The cables which are buried underground shall be laid at depth of at least 1 metre and shall be protected by bricks on two sides and at the top.

The cables for emergency lighting, fire alarm systems, etc., shall run on separate trays.

All cables laid by the contractor shall be terminated at both ends. The contractor shall make all electrical connections strictly in accordance with the contractor's cable schedule approved by Owner and shall provide numbered ferrules at each connecting terminal in order to check connections without any difficulty. Terminal blocks have been provided in various panels/equipment for these terminations. One termination shall mean connecting both ends of one core of a cable to given terminal blocks. The cables shall be terminated by crimping lugs to the ends.

Jointing compound, 1.1 kV jointing kits, termination kits, button tape, PVC tape, cotton tapes etc. shall be supplied by contractor and used as part of consumable material. However joints shall be avoided as far as possible.

The cables shall be handled with care so as to avoid kinking and damage. Sufficient slack shall be allowed in each run of cable to permit contraction and expansion. Suitable loops between gland and terminating point shall also be provided.

Contractor shall take proper care in the handling of cables against external damage of any kind. Necessary rollers etc. shall be used while pulling and laying of the cables. Owner shall have the right to stop the work in case of improper handling of the cables.

Cables shall be properly clamped at regular intervals with the help of non magnetic/moulded fiber glass strip clamps/PVC sleeved clamps, of suitable size. Contractor shall submit typical drawings along with tender giving proposed clamping arrangement and also give distance of clamping at bends and in regular run of cables.

ii. Cable Markers and Cable Binding

Suitable cable markers of aluminium with punch marks shall be provided and suitably tagged to the cable permanently so that cable could be easily identified.

iii. Cable Binding/Strapping

All control cables after glanding shall be neatly routed and binded with the help of cable straps and studs inside the panel. Complete routing in panel shall be such that it gives a neat appearance good workmanship.

For L.T. Power cables, suitable holding clamps will be provided in the panel if required.

The contractor shall also be responsible for sealing the spare holes and panel circuits with the help of suitable blanking plates or mutually agreed method.

The contractor shall do the cable glanding suitable for each cable size at both ends of termination of each cable.

9.2.11 Field Tests

Before commissioning of complete system all cabling system shall be checked as per cable schedule and complete report shall be prepared by contractor and shall be submitted.

Field test shall include:

E.E. (E-M),
0/0 the CE, DHPD, Itanagar

Cabling checking
Continuity checking
Megger testing in accordance with the applicable codes and standards.
Resistance checking

Contractor shall be responsible for conducting tests as per IS / IEC before termination of the cables i.e. measuring insulation resistance of each core to earth and core to core, identification of cores, all tests before and after termination etc. Contractor shall be fully responsible for correct terminations and if at the time of commissioning some modifications/rectifications are required the same shall also be carried out by him. If any terminations/cable boxes etc. fail at the time of commissioning, Contractor shall be responsible to replace the same.

9.2.12 Spare Parts

The supplier shall supply spare parts as per General Technical Specification 3A. In addition the supplier shall submit a detailed proposal on recommended spares and consumables for five (5) years operation. This proposal shall be prepared under due consideration of the requirement of the General Technical Specification.

9.2.13 Tools

In addition to the tools listed in general technical specification the contractor shall provide one set of all necessary tools for erection, testing, commissioning, repair and maintenance as recommended by the manufacturer. A list of such tools shall be furnished with the bid.

9.3 Fire Protection Equipment / System For The Power House

Portable Fire Extinguishers of following types of requisite capacity shall be located at appropriate locations in the power house as below for extinguishing of general fire, electrical fire, chemical fire:

- | | | | |
|----|---|---|---|
| a. | Trolley mounted CO ₂ type | : | 2 cylinders |
| b. | CO ₂ type fire extinguishers | : | 2 Nos. |
| c. | Carbon Tetra-Chloride type | : | 1 No. for General electrical installations, |
| d. | Any other type as required. | | |

9.3.1 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 power house area.

9.3 Lighting in Power House, Switchyard and Appurtenant works:

9.3.1 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.

9.3.2 Standards

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

9.3.3 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.

9.3.4 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 24 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.

24V DC emergency lighting shall be provided in following areas:

- | | | |
|----|---|-------------------|
| a. | Machine hall | 20 lux |
| b. | Control room | 100 lux |
| c. | Exit points | 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.

E.E. (E-M),
0/0 the CE, DHPD, Itanagar

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 preferably 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 preferably 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.

9.3.5 Illumination Levels And Type of Fixtures And Luminaries

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

The lighting plan shall have to be got approved by the contractor from the Department.

E.E. (E-M),
0/0 the CE, DHPD, Itanagar