

**TECHNICAL SPECIFICATION  
FOR  
LT DISTRIBUTION BOX**

**L.T. DISTRIBUTION BOX FOR 100KVA 33/0.4 KV Transformer (3 phase, 200A)**

**1. DESCRIPTION OF MATERIALS:-** The L.T. Distribution Cabinets shall be installed on D.P. Structure for Plinth Mounted 33/.4 KV Substation of the ratings indicated above. These Distribution Cabinets are to be outdoor type and to be fabricated out of 2 mm GI sheet steel. The body of the boxes shall have sufficient re- enforcement with suitable size of channels keeping a provision for fixing these boxes either on DP structure or plinths.

1.1 The Box shall have double door with self locking ( When the main MCCB is in close position the inner door can not be opened and after closing of the inner door only the main MCCB can be closed) arrangement and a door handle conforming to **general quality conditions. Any compromise on quality of the door handle used shall be liable for rejection.** The roof of the box shall be slightly slanting both sides as per drawing with an over hang of 50 mm to the front and back side. **Locking arrangement shall be Godrej Type, 3 Position Locking System for better Security. However, a separate provision for manual locking arrangement shall also be provided as stand by.**

1.2 The nuts, bolts, washers used in the box shall be galvanized to avoid rusting. The door hinges shall not be visible from outside. The box shall have two no.s of solid Earthing points on either side with an arrangement for sufficient ventilation.

1.3 The boxes should confirm to IP-55 degree of protection. The bidders shall have to enclose type test certificate for degree of protection (IP-55) after their product duly tested at CPRI or any Govt. approved laboratory failing which their bid is liable for rejection. Preference shall be given to those who have successfully conducted type test as mentioned above.

1.4 The box shall have provision of bus bars of Copper mounted on epoxy resin cast bus insulators fixed on suitable fixing arrangement. The bus bars shall be conveniently placed so as to provide adequate clearance from the body of the box conforming to I.E. Rules applicable for L.T. supply with provision for one Bus Bar arrangement with 4 pole MCCB for all capacities of LTDBs & 1 number of outgoing feeder arrangement with 2sets of three pole MCCBs in each feeder for 100KVA LTDB. The Bus-Bar

arrangement may be suitably made to house one out-going feeders with sufficient clearance between phases inside the LT Distribution Boxes.

There should be Heat Shrinkable bus bar insulation tubing of Red Yellow-Blue & Black. Alternatively phase coloured insulated paint (not less than 3.0kv) should be applied on the Bus-Bars.

1.5 The arrangement and dimensions shall be as per the drawing enclosed.

1.6 The provision of Earthing is to be made up with **Copper Flat of Size 25x4mm**. Suitable cable glands of heavy duty, double compression type **made up of Brass** shall be provided at the bottom of the Box. One for incoming cable and one outgoing cable. Detachable plates shall be provided for fixing of cable glands.

1.6 The Drawings shown below are indicative. Prior to manufacturing the bidder shall submit detail drawing with arrangement of Bus bar, MCCB phase indicator lamps etc for approval by the purchaser.

**2.0 MCCB** :-MCCB shall be of reputed make preferably of L&T, Siemens, Havells, MDS and .ABB.(Make must be specified in the tender)

The purchaser reserves the right to chose any one out of 4/3 Pole M.C.C.B.

- i) Standard :-IS-13947  
(Part-2) / 1993 & IEC Pub – 947 – 2 (1989)
- ii) Rated Voltage : 415V.AC.
- iii) No. of Poles :-  
4pole for incomer & 3pole for Outgoing feeders' protection.
- iv) Rated current : ,200A,

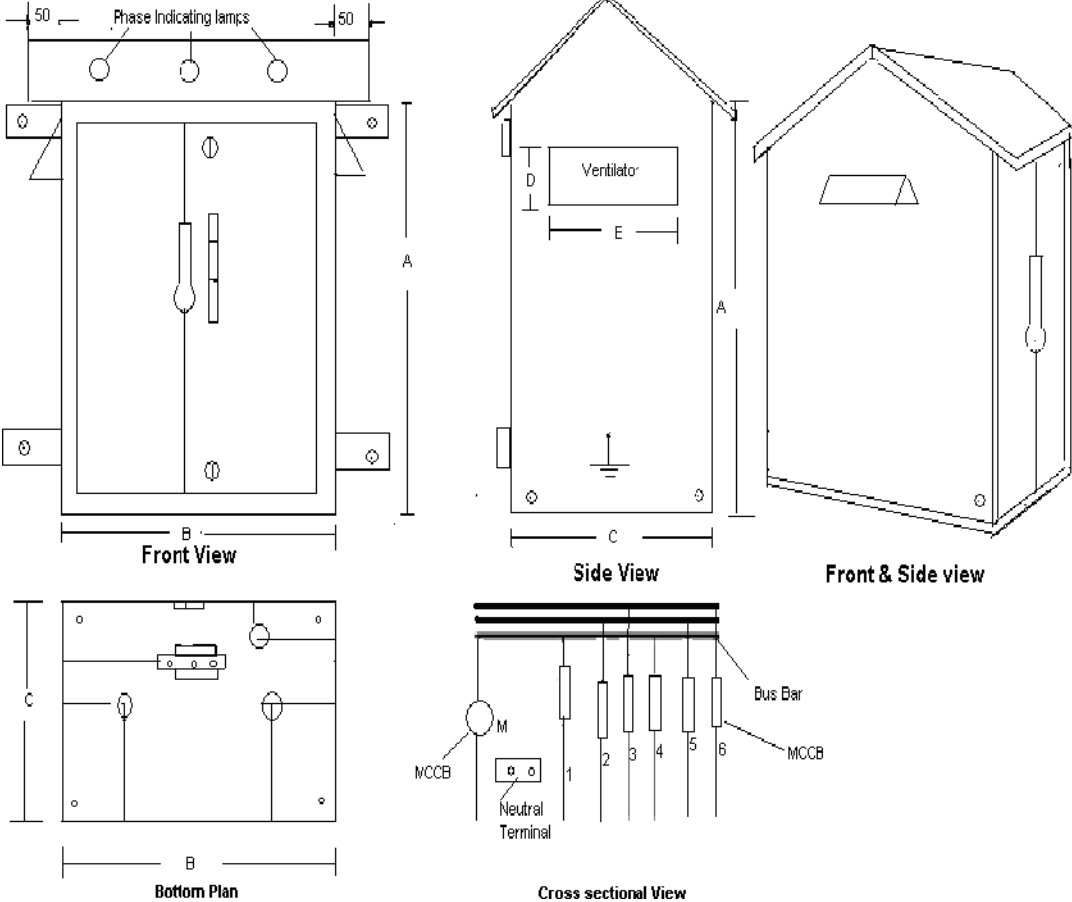
The percentage of rated service short circuit breaking capacity to rated ultimate short circuit breaking capacity shall be mentioned as per the Table - I, Page -13 of IS - 13947 (Part - 2).

All other features of the MCCB shall conform to the ISS : 13947 (Pt. - 2) / 1993 & IEC Pub - 947 (Pt. 2) /1989.

Preferably the rated ultimate Short Circuit Breaking Capacity is as follows,  
The Percentage(%age of Rated Service short Circuit breaking capacity(Ics) to Rated Ultimate Short circuit Breaking Capacity(Icu) shall be mentioned as per Table-1 ,Page-13 of IS:13947(part-2)/1 989.

- vi) Type of protection: - Overload & short circuit protection is a must with static/electro magnetic/thermo magnetic trip release with manual resetting. For Neutral un-balance current protection the bidders are to furnish alternative rates as indicated above.

**DRAWING** for L.T Distribution Box for 63 KVA, 100KVA to 200 KVA Transformers



**N.B :**  
 Separate terminal bar to be provided for Neutral connection.

Details:-

SI No	Dimension Description	63 KVA	100 KVA	200 KVA
1	A	700	1000	1000
2	B	600	800	800
3	C	400	500	500
4	D	80	170	170
5	E	90	250	250
6	Incomer 4Pole MCCB	100 A, with Over Current	200 A, with Over Current Setting 80% to 100%	400 A, with Over Current Setting 80% to 100%
7	Cable Size for Incomer	50 mm <sup>2</sup> , 3 1/2 core cable	95 mm <sup>2</sup> , 3 1/2 core cable	185 mm <sup>2</sup> , 3 1/2 core cable
8	Three Pole MCCB for out- going feeder	50 Amp, with Over Current Setting 80% to 100%	100 Amp, with Over Current Setting 80% to 100%	200 Amp, with Over Current Setting 80% to 100%
9	Bus Bar for Incoming & Out going feeders	25 x 6 mm	40 x 6 mm	50 x 8 mm
10	Bus Bar material	Electrolytic Aluminium	Electrolytic Aluminium	Electrolytic Aluminium
11	A neutral Bus bar similar to phase Bus bar is to be provided.			

N.B. : - 1 ) 4Pole MCCB for Incomer & 3pole MCCB for outgoing feeder for individual tripping of each phase due to faults in the respective phases in the outgoing feeder, of reputed make to be specified in the tender along with test report from CPRI / Govt. testing lab. It shall confirm to IS – 13947 (pt – 2 ) / 1993 with latest amendment. The bidder should also furnish the purchase order of MCCBs with serial number for verification of genuineness of the MCCBs.

The in-coming cable should be connected to the terminals of the M.C.C.B. with Bi-metallic lugs preferably of Usha Martin make duly crimped with Die-less crimping tools. There should be a metallic/heat resistant insulating barrier between the individual M.C.C.Bs so that the heat generated during any fault inside the Box should not pass to the other M.C.C.Bs.

### **General Technical Particulars for LT Distribution Boxes : -**

- 1) The L.T. Distribution Boxes should be of the dimensions as per the drawing & details in the table furnished.
- 2) The bidders can quote with their own design suitably accommodating the components as indicated in this bid in conforming to the approved clearances and technical requirements. The dimensions are only illustrative. Tolerances of dimensions are 10% over & above the dimensions specified. The bidder may specify their own dimensions and quote accordingly. The drawing and dimension should be submitted with the bidding document.
- 3) The distribution boxes shall be duly wired with suitable size of PVC insulated single core copper cable or equivalent section copper / aluminum flat.
- 4) Terminal connectors for the earth connections to be provided in the box.
- 5) The distribution cabinet should be preferably of IP-55 protective category, with provision for lighting inside the cabinet. Purchaser's Name & Sl. No. Punching Marks should be given on any one of the sidewalls of each box as an identification of Purchaser's property, besides furnishing a non-detachable Nameplate, which should exhibit the details of L.T. Distribution Cabinet.
- 6) **TESTS** : - The 4 pole & Three pole M.C.C.Bs. to be mounted with Distribution Boxes shall have been fully type tested as per the relevant standard at CPRI/ Govt. approved laboratory/NABL accredited laboratory. The bid shall be accompanying with type-test reports conducted at Central Power Research Institute / Govt. approved laboratory for the offered materials conducted within five years before the date of opening of the tender. Copies of type test reports in respect of Impulse and Short Circuit tests must be enclosed with the tender failing, which the Bid is liable for rejection. Purchaser reserves the right to demand repetition of the tests without any extra cost.

**Bids not accompanied with type test reports conducted within five years shall not be considered for evaluation.**

### **7.) INSPECTION :-**

- (a) The inspection may be carried out by the Purchaser at any stage of manufacture. The successful tenderer shall grant free access to the Purchaser's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the Purchaser shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the

equipment is found to be defective.

- (b) The supplier shall keep the Purchaser informed in advance about the manufacturing programme so that arrangement can be made for inspection.
- (c) The purchaser reserves the right to insist for witnessing the acceptance / routine testing of the bought out items.

#### **8.) ACCEPTANCE AND ROUTINE TESTS :-**

All acceptance and routine tests as stipulated in the relevant standards shall be carried out by the supplier in presence of owner's representative.

#### **9.) DOCUMENTATION :-**

The Bidder shall furnish the following drawings along with the offer.

General outline and assembly drawing of the L.T. Distribution Box

- 1 .                    C r o s s   S e c t i o n a l   v i e w
- 2.                    A r r a n g e m e n t   o f   t e r m i n a l s   &   d e t a i l s   o f   c o n n e c t i o n   s t u d s   p r o v i d e d
- 3 .                    N a m e   p l a t e
- 4 .                    S c h e m a t i c   d r a w i n g
- 5.                    T y p e   t e s t   r e p o r t s ,   i n   c a s e   M C C B   h a s   a l r e a d y   b e e n   t y p e   t e s t e d
- 6.                    T e s t   r e p o r t s ,   l i t e r a t u r e   o f   t h e   b o u g h t   o u t   i t e m s   a n d   r a w   m a t e r i a l s
- 7.                    T e s t i n g   f a c i l i t i e s   a v a i l a b l e   a t   t h e   w o r k s
- 8.                    L i s t   o f   c u s t o m e r s   w i t h   d e t a i l e d   a d d r e s s   /   p u r c h a s e   r e f e r e n c e ,   q u a n t i t y   a n d   y e a r   o f   s u p p l y   w i t h   u s e r   c e r t i f i c a t e   f o r   s u c h   i t e m s .

**10) COMPLETENESS OF EQUIPMENT :-** Any fittings accessories or apparatus which may not have been specifically mentioned in this specification but which are usually necessary in equipment of similar plant shall be deemed to be included in the specification and shall be supplied by the Tenderer without extra charge. All plant and equipment shall be complete in all details whether such details are mentioned in the specification or not.

## 12) INSPECTION AND TESTING

The Purchaser shall have free entry at all times, while work on the contract is being performed, to all parts of the manufacturer's works which concern the processing of the equipment ordered. The manufacturer shall afford the Purchaser without charge, all reasonable facilities to assure that the equipment being furnished is in accordance with this specification.

The equipment shall successfully pass all the acceptance tests and routine tests referred to and those listed in the most recent edition of the standards given in this specification.

The Purchaser reserves the right to reject an item of equipment if the test results do not comply with the values specified or with the data given in the technical data schedule.

Type tests shall have been / shall be carried out at CPRI / National Govt. approved Laboratory and be witnessed by a representative of such laboratory. Routine tests shall be carried out by the Supplier at no extra charge at their works.

Adequate facility with calibrated testing equipment must be provided by the manufacturer free of cost to carry out the tests. Type test certificates must be furnished along with the tender for reference of the Purchaser.

All costs in connection with the testing, including any necessary re-testing, shall be borne by the Supplier who shall provide the Purchaser with all the test facilities which the latter may require, free of charge. The Purchaser shall have the right to select the samples for test and shall also have the right to assure that the testing apparatus is duly calibrated and correct. Measuring apparatus for routine tests shall be calibrated at the expense of the Supplier at an approved laboratory and shall be approved by the Purchaser.

The Supplier shall be responsible for the proper testing of the plant or materials supplied by sub-suppliers to the same extent as if the work, plant or materials were completed or supplied by the Supplier.

Any cost, incurred by the Purchaser in connection with inspection and re-testing as a result of failure of the equipment under test or damage during transport or offloading shall be to the account of the Supplier.

The supplier shall submit to the Purchaser five signed copies of the test certificates, giving the results of the tests as required. No materials shall be despatched until the test certificates have been received by the Purchaser and the Supplier has been informed that they are acceptable.

The test certificates must show the actual values obtained from the tests, in the units used in this specification, and not merely confirm that the requirements have been met.

In the case of components for which specific type tests or routine tests are not given in this specification, The Supplier shall include a list of the tests normally required for these components. All materials used in the Contract shall withstand and shall be certified to have satisfactorily passed such tests.

The Purchaser at his discretion may re-confirm the Test Results in his own laboratory or laboratory of his choice.



No inspection or lack of inspection or passing by the Purchaser's Representative of equipment or materials whether supplied by the Supplier or sub-supplier, shall relieve the Supplier from his liability to complete the contract works in accordance with the contract or exonerate him from any of his guarantees.

**TECHNICAL SPECIFICATION  
FOR  
HARDWARE FITTINGS**

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OF  
HARDWARE FITTINGS

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## **TECHNICAL SPECIFICATION FOR HARDWARE FITTINGS**

### **1.0 SCOPE**

This Specification covers design manufacture, testing at manufacturer's Works, supply and delivery of power conductor accessories, insulator and hardware fittings for string insulators suitable for use in 33 kV and 11 kV Overhead transmission lines and sub-stations of OPTCL. The hardware to be supplied shall be as per approved drawings of OPTCL. Any change there of shall be with due permission of OPTCL. The firm shall submit his drawings for approval of OPTCL and only after which the manufacturing shall be started.

The materials/equipment offered, shall be complete with all components, which are necessary or usual for the efficient performance and satisfactory maintenance. Such part shall be deemed to be within the scope of contract.

### **2.0 STANDARDS**

The materials covered under this Specification shall comply with the requirement of the latest version of the following standards as amended up to date, except where specified otherwise.

- |      |                       |   |
|------|-----------------------|---|
| i)   | IS:2486 Part-II & III | Insulator fitting for overhead power lines with a nominal voltage greater than 1,000 volts. |
| ii)  | IS:2121 Part I & II   | Conductor & earth wire accessories for overhead power lines.                                |
| iii) | IS:9708               | Stock Bridge Vibration Dampers on overhead power lines.                                     |
| iv)  | IS:2633               | Method of testing of uniformity of coating on zinc coated articles                          |
| v)   | IS:209                | Specification for Zinc.   |
| vi)  | BS:916                | Specification for Hexagonal bolts and nuts.   |

### **3.0 MATERIALS AND DESIGN**

Aluminium and aluminium alloys, malleable iron and forged steel, having required mechanical strength, corrosion resistance and machinability depending on the types of application for which accessories / fittings are needed, shall be employed.

In manufacturer of the accessories / fittings, the composition of the aluminium alloys used shall be made available to Employer if required for verification.

The materials offered shall be of first class quality, workmanship, well finished and approved design. All castings shall be free from blow-holes, flaws, cracks of other defects and shall be smooth, close grained and true forms and dimensions. All machined surfaces should be free, smooth and well finished.

Metal fittings of specified material for conductor and earth wire accessories and string insulator fittings are required to have excellent mechanical properties such as strength, toughness and high resistance against corrosion. All current carrying parts shall be so designed and manufactured that contact resistance is reduced to the minimum.

All bolts, nuts, bolt-heads shall be the white worth's standard thread. Bolt heads and nuts shall be hexagonal. Nuts shall be locked in an approved manner. The treads in nuts and tapped holes shall be cut after galvanizing and shall be well fabricated and greased. All other treads shall be cut before galvanizing. The bolt treads shall be undercut to take care of increase in diameter due to galvanizing.

All nuts shall be made of materials to Clause 4.8 of IS:1367 (latest edition) with regard to its mechanical properties.

The general design conductor and earth wire accessories and insulator fittings shall be such as to ensure uniformity, high strength, free from corona formation and high resistance against corrosion even in case of high level of atmosphere pollution.

All hooks, eyes, pins, bolts, suspension clamps and other fittings for attaching to the tower or to the line conductor or to the earth wire shall be so designed that the effects of vibration, both on the conductor and the fittings itself, are minimized.

Special attention must be given to ensure smooth finished surface throughout. Adequate bearing area between fittings shall be provided and point or line contacts shall be avoided.

All accessories and hard wares shall be free from cracks, shrinks, slender air holes, burrs or rough edges.

The design of the accessories and hard wares shall be such as to avoid local corona formation or discharge likely to cause interference to tele-transmission signals of any kind.

#### **4.0 GENERAL:**

1. All ferrous parts including fasteners shall be hot dip galvanized, after all machining has been completed. Nuts may however be tapped (threaded) after

galvanizing and the threads oiled. Spring washers shall be electro-galvanized. The bolt threads shall be undercut to take care of the increase in diameter due to galvanizing. Galvanizing shall be done in accordance with IS-2629-1985 and shall satisfy the tests mentioned in IS: 2633-1986. Fasteners shall withstand four dips while spring washers shall withstand three dips of one-minute duration in the standard Preece test. Other galvanized materials shall be guaranteed to withstand at least six successive dips each lasting one minute under the Standard Preece test for galvanizing.

2. The zinc coating shall be perfectly adherent of uniform thickness, smooth, reasonably bright, continuous and free from imperfections such as flux, ash, rust stains, bulky white deposits and blisters. The zinc used for galvanizing shall be of grade Zn 99.95 as per IS 209-1979.
3. Pin balls shall be checked with the applicable "G" gauges in at least two directions, one of which shall be across the line of die flashing and the other 90 deg. to this line. 'NO GO' gauges shall not pass in any direction.
4. Socket ends, before galvanizing shall be of uniform contour. The bearing surface of socket ends shall be uniform about the entire circumference without depressions or high spots. The internal contours of socket ends shall be concentric with the axis of the fittings as per IS 2486/IEC-120. The axis of the bearing surfaces of socket ends shall be coaxial with the axis of the fittings. There shall be no noticeable tilting of the bearing surfaces with the axis of the fittings.
5. All current carrying parts shall be so designed end manufactured that contact resistance is reduced to minimum.
6. Welding of aluminum shall be by inert gas shielded tungsten arc or inert gas, shielded metal arc process. Welds shall be clean, sound, smooth, and uniform without overlaps, properly fused and completely sealed. There shall be no cracks, voids incomplete penetration, incomplete fusion, under-cutting or inclusions Porosity shall be minimized so that mechanical properties of the aluminum alloys are not affected. All welds shall be properly finished as per good engineering practices.

#### **5.0 Electrical Design:**

The normal duty and heavy duty suspension, light duty, normal duty and heavy duty tension insulator sets shall all comply with the technical requirements and satisfy the test requirements

#### **6.0 Mechanical design:**

The mechanical strength of the insulators and corresponding insulator fittings must match .The design shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to the development of defects.

Insulating material shall not engage directly with hard metal. All fixing materials shall be of approved quality, shall be applied in an approved manner and shall not enter into chemical action with the metal parts or cause fracture by expansion in service. Where cement is used as a fixing medium, cement thickness shall be as small and even as possible and proper care shall be taken to correctly centre and locate the individual parts during cementing.

**7.0 GALVANISING:**

All ferrous parts of conductor and ground wire accessories and insulator hardware shall be galvanized in accordance with IS: 2629-Recommended Practice for hot dip galvanizing of iron and steel or any other equivalent authoritative standards. The weight of zinc coating shall be determined as per method stipulated in IS: 2633 for testing weights, thickness and uniformity of coating of hot dip galvanized articles or as per any other equivalent authoritative standards. The zinc used or galvanization shall conform to grade zn 98 of IS: 209. The galvanized parts shall withstand four (4) dips of 1 minute each time while testing uniformity of zinc coating as per IS: 2633.

Spring washers shall be electro galvanized.

**8.0 INSULATOR HARDWARES**

The insulator disc hardware and string assemblies to be offered by the tenderer shall be suitable to meet the requirement given in the specific technical particulars as detailed hereinafter.

Hardware for suspension and tension insulator shall be suitable for insulator with normal pin shank diameter of 20 mm. in case of tension string unit and 16mm. for suspension string unit.

Each insulator string shall generally include the following hardware components.

<b>Single Suspension Set.</b>	<b>Double Suspension Set.</b>
a) Ball Hook.	i) Ball Hook.
b) Tower / Pole side arcing horn	(i) Socket clevis with R-Type security clip-3 Nos.
c) Socket Eye with R-Type security clip.	(ii) Yoke Plate-2 Nos.
d) Line side arcing horn.	(iii) Tower / Pole side arcing horns-2Nos.
e) Suspension clamps Armoured Grip Suspension AGS Type	(iv) Ball clevis – 2 Nos.
	(v) Line side arcing horns-2 Nos.
	(vi) Clevis Eye.
	(vii) Suspension Clamp. Armoured Grip Suspension AGS Type

**Single Tension Set :**

- a) Anchor Shackle.
- b) Ball Eye.
- c) Tower / Pole side arcing horn.
- d) Socket Clevis with R-Type security clip.
- e) Line side arcing horn
- f) Bolted type dead end clamp.

**Double Tension Set :**

- a) Anchor Shackle.
- b) Chain Link.
- c) Yoke Plate – 2 Nos.
- d) Tower / Pole side arcing horn.
- e) Ball Clevis – 2 Nos.
- f) Socket Clevis with R-Type security clip – 2 Nos.
- g) Line side arcing horns.
- a) Bolted type dead end clamps.

**9.0 SUSPENSION CLAMPS**

This clamp will be AGS type made out of aluminum alloy suitable for accommodating preformed armored rod.

**10.0 TENSION CLAMPS**

The Tension Clamps shall be made out of aluminium alloy and of 4 **pair** bolted **(M-16)** type suitable for 100 mm<sup>2</sup> & 150 mm<sup>2</sup> AAAC conductor .The tension clamps shall not permit slipping or damage to failure of the complete conductor or any part thereof at a load less than 90% of the ultimate strength of conductor. The mechanical efficiency of tension / clamps shall not be affected by method of erection involving come / along or similar clamps or tension stringing operation during or after assembly and erection of tension clamp itself. The tension clamp shall be of a design that will ensure unrestricted flow of current without use of parallel groove clamps.

The clamps shall be as light as possible.

**11.0 ARCING HORNS**

Each hardware assembly shall have provision for attaching arcing horns of both adjustable and non/adjustable type across the suspension and tension strings or tower side. However each hardware assembly shall be provided with arching horn of fixed type on line side only.

**12.0 TESTS, TEST CERTIFICATE AND PERFORMANCE REPORTS**

12.1 The fittings and accessories for the power conductor, insulator and hardwares shall be tested in accordance with IS:2121, IS:2486, BS:916 for hexagonal bolts and nuts Six sets of type and routine test certificates and performance reports are to be submitted by the Contractor.



The Employer however, reserves the right to get all the tests performed in accordance with the relevant I.S. Specification as Acceptance Test in presence of Employer-s representatives.

The tenderer shall clearly state the testing facilities available in the laboratory at his Works and his ability to carry out the tests in accordance with this Specification. All the specified tests shall be carried out without any extra cost.

Acceptance Test for power conductor accessories.

- a) Visual examination
- b) Dimensional verification
- c) Failing load test
- d) Slip strength test (for clamps)
- e) Electrical resistance test
- f) Fatigue test (for vibration dampers)
- g) Mass pull off test (for vibration dampers)
- h) Galvanizing test.

## 12.2 ACCEPTANCE TEST FOR HARDWARES

- i) Dimensional verification.
- ii) Ultimate tensile test.
- i) Slip strength test.
- ii) Electrical resistance test.
- iii) Heating cycle test
- iv) Breaking strength of full string assembly.
- v) Galvanizing test.

## 13.0 BONDING PIECES:

- a) material : flexible copper bond (37/7/0.417 mm. tinned copper flexible stranded cable).
- b) Length : Not less than 750 mm.
- c) Bolt size : 16mm x 40 mm.
- d) Copper area. : 34 sq.mm.
- e) Thickness of log : 6 mm.
- f) Material for connecting socket : Tinned Brass

## 14.0 FASTENERS: Bolts, Nuts & Washers

1. All bolts and nuts shall conform to IS-6639 – 1972. All bolts and nuts shall be galvanized. All bolts and nuts shall have hexagonal heads, the heads being truly concentric, and square with the shank, which must be perfectly straight.

2. Bolts upto M16 and having length upto ten times the diameter of the bolt should be manufactured by cold forging and thread rolling process to obtain good and reliable mechanical properties and effective dimensional control. The shear strength of bolt for 5.6 grade should be 310 Mpa minimum as per IS-12427. Bolts should be provided with washer face in accordance with IS-1363 Part-I to ensure proper bearing.
3. Fully threaded bolts shall not be used. The length of the bolt shall be such that the threaded portion shall not extend into the place of contact of the component parts.
4. All bolts shall be threaded to take the full depth of the nuts and threaded enough to permit the firm gripping of the component parts but not further. It shall be ensured that the threaded portion of the bolt protrudes not less than 3 mm and not more than 8 mm when fully tightened. All nuts shall fit and be tight to the point where shank of the bolt connects to the head.
5. Flat washers and spring washers shall be provided wherever necessary and shall be of positive lock type. Spring washers shall be electro-galvanized. The thickness of washers shall conform to IS-2016-1967.
6. The bidder shall furnish bolt schedules giving thickness of components connected, the nut and the washer and the length of shank and the threaded portion of the bolts and size of holes and any other special details of this nature.
7. To obviate bending stress in bolt, it shall not connect aggregate thickness more than three time its diameter.
8. Bolts at the joints shall be so staggered that nuts may be tightened with spanners without fouling.
9. Fasteners of grade higher than 8.8 are not to be used and minimum grade for bolts shall be 5.6.

## **15.0 Technical Specification for Design, Supply and Testing of Hard ware fittings.**

### **15.1 Type tests:**

The following type tests shall be conducted on hardware fittings.

#### **A. On suspension hardware fittings only.**

- (i) Magnetic power loss test.
- (ii) Clamp slip strength Vs torque
- (iii) Mechanical strength test.
- (iv) On one test on elastomer.

#### **B. On Tension hard ware fittings only.**

- (i) Electrical resistance test for IS 2486 (Part-I) 1971  
Dead end assembly.
- (ii) Heating cycle test for -do-  
Dead end assembly.
- (iii) Slip strength test for IS 2486 (Part-I)  
Dead end assembly.
- (iv) Mechanical strength test.

**C. On both suspension and tension hardware fittings.**

- (i) Visual examination. IS-2486 (Part-I) 1971
- (ii) Verification of dimension. -do-
- (iii) Galvanizing / electroplating test. -do-
- (iv) Mechanical strength test of each component  
(including corona control ring/grading ring and arcing horn)
- (v) Mechanical strength test of welded joint.
- (vi) Mechanical strength test for corona control ring/  
grading ring and arcing horn. BS-3288 (Part-I)
- (vii) Test on locking device for ball and socket coupling. IEC –  
3721984
- (viii) Chemical analysis, hardness tests, grain size,  
inclusion rating and magnetic particle inspection for  
forging/casting.

**D. On suspension hardware fittings only.**

- (i) Clamp slip strength ver as torque test for suspension clamp.
- (ii) Shore hardness test of elastomer cushion for AG suspension  
clamp.
- (iii) Bend test for armour rod set. IS-2121 (Part-I)
- (iv) Resilience test for armour rod set. -do-
- (v) Conductivity test for armour rod set. -do-

All the acceptance tests stated at clause shall also be carried out on composite insulator unit, except the eccentricity test at clause. In addition to these, all the acceptance tests indicated in IEC 1109 shall also be carried out without any extra cost to the employer.

**E. For hardware fittings.**

- (a) Visual examination. IS-2121 (Part-I)
- (b) Proof & test.

**F. Tests on conductor accessories.**

**G. Type tests.**

**H. Mid span compression joint for conductor and earth wire.**

- (a) Chemical analysis of materials.
- (b) Electrical resistance tests. IS-2121 (Part-II) 1981 clause 6.5 & 6.6
- (c) Heating cycle test. -do-
- (d) Slip strength test. -do-

**TECHNICAL SPECIFICATION  
FOR  
EQUIPMET CLAMPS & CONNECTORS**

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OF  
EQUIPMET CLAMPS & CONNECTORS**

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**TECHNICAL SPECIFICATION FOR EQUIPMET CLAMPS & CONNECTORS**

**1.0 SCOPE**

This specification covers design, manufacture, assembly, testing at manufacturer's works, supply and delivery at site of all terminal connectors of 33KV equipment (mainly breaker, isolator, CT,PT,CVT,BPI and SA) and all other clamps and dropper connectors required for the switch yard as per approved lay out and system design.

## **2.0 STANDARDS**

The terminal connectors under this specification shall conform strictly to the requirements of the latest version of the following standards as amended up-to-date, except where specified otherwise.

- i) IS: 556 Power Connectors.
- ii) IS: 617 Aluminium & Aluminium Alloy
- iii) IS: 2629 Recommended Practice for hot dip galvanizing of iron and steel.
- iv) IS: 2633 Method of testing uniformity of coating of zinc coated articles.

The materials conforming to the standards are only acceptable. The salient point of these specifications and points of difference between these and the above specifications shall be clearly brought out in the bid.

## **3.0 MATERIAL & WORKMANSHIP**

The terminal connectors shall be manufactured from Aluminium Silicon Alloy and conform to designation A6 of IS: 617 (latest edition)

The connectors shall be of best quality and workmanship, well finished and of approved design. Specific materials for clamps and connectors should have high current carrying capacity, high corrosion resistance and be free from corona formation.

All connectors or its components to be connected with conductor shall be of bolted type having aluminium purity not less than 99.5%.

All bus bar clamps shall be made preferably from forged aluminium of purity not less than 99.5%. The thickness and contact surface should be maintained in such a way that the clamp should conform to IS:5561/1970 or any latest revision thereof.

#### 4.0 RATING

The connector rating shall match with the rating of the respective equipment for the terminal connectors and the connectors for bus bar and dropper should be of the following rating. Minimum thickness at any part of connector shall be 10(ten) mm. Indicative ratings are given below:

SI No.	Rating	33 KV
1	Main bus bar connectors high level and low level (Amps)	1250
2	High level bus sectionalisation Isolator (Amps)	1250
3	-do- for CT	As per CT rating
4	-do- for PI	As per PI rating
5	-do- for LA	As per LA rating
6	-do- for PT	As per PT rating

#### 5.0 EQUIPMENT CONNECTORS

Bimetallic connectors shall be used to connect conductors of dissimilar metal. The following bimetallic arrangement shall be preferred.

- a) Copper cladding of minimum 4 mm. thickness on the aluminium portion of connector coming in contact with the copper palm or stud of the equipment.
- ii) Alternatively, to provide cold rolled aluminium copper strip between the aluminium portion of the connection, the sheet thickness shall not be less than 2 mm.

Sufficient contact pressure should be maintained at the joint by the provision of the required number of bolts or other fixing arrangements, but the contact



pressure should not be so great as to cause relaxation of the joint by cold flow, the joint should be such that the pressure is maintained within this range under all conditions of service, to avoid excessive local pressure, the contact pressure should be evenly distributed by use of pressure plates, washers or suitable saddles of adequate area of thickness should be less than that of an equal length of conductor where measured individually test results showing the milli drop test and resistance should be enclosed with the bid.

All connectors shall be so designed and manufactured as to offer ease of installation as these are to be used in overhead installations, design shall be such that full tightening of nuts and bolts should be possible with the use of double wrench.

The connectors shall be such as to avoid local corona, sound or visible discharge.

## **6.0 TEMPERATURE RISE**

The temperature rise of connectors when carrying rated current shall not exceed 45° C above reference design temperature of 50° C.

- i) Acceptance Tests
  - (a) Tensile Test
  - (b) Temperature rise test
  - (c) Temperature rise test
- ii) Routine Test
  - (a) Visual Inspection
  - (b) Dimensional Check

Type test reports from a recognized laboratory shall have to be submitted.

## **7.0 WEIGHTS**

Weights of different materials used in manufacture, such as aluminium, silicon, copper etc. should be clearly indicated in GTP & Drawing.

## 8.0 INTERCHANGE ABILITY

Corresponding parts of similar clamps and connectors shall be made to gauge or jig and shall be interchangeable in every respect.

## 9.0 SCHEDULE FOR TECHNICAL REQUIREMENTS:

### 9.1 TENSION CLAMPS

Sl. No.	Details (TENSION CLAMPS)	Suitable for AAAC (150/100mm <sup>2</sup> )

### 9.1 SUSPENSION CLAMPS

Sl. No.	Details (SUSPENSION CLAMPS)	Requirement: Suitable for AAAC (150/100mm <sup>2</sup> )


**9.2 FLEXIBLE CUPPER BOND**

Sl. No.	Details (Flexible Cupper Bond)	Requirement:



**TECHNICAL SPECIFICATION  
FOR  
HG FUSES**

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OF  
33KV & 11KV H.G. FUSE

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# TECHNICAL SPECIFICATION FOR 33KV & 11KV, 400A, 3 POLE HG FUSES

## 1.0 SCOPE

This specification covers the design manufacture, shop testing, loading, transportation and delivery at sub-station site of 33KV, 400Amp, 3Pole & 11KV, 400Amp, 3Pole H.G. Fuse Sets for outdoor installations to be used at 33/11KV Sub-stations.

## 2.0 STANDARDS: - The H.G. Fuse Set shall conform to the following standards:-

- i) IS- 5792- 1973 (For high voltage expulsion fuses & similar fuses)
- ii) IS-2544-1973 (for porcelain post insulators)
- iii) IS-9385-1979 or its latest amendments if any.
- iv) IS-2633-1979 (For Galvanization of ferrous parts)

## 3.0 INSULATORS:-

The 12KV & 22KV/ 24KV post insulators complete with pedestal cap duly cemented to be used in the H.G. Fuse sets confirming to IS-2544/1973.

The type of insulation materials, metal fittings, Creepage distance, protected Creepage distance, tensile strength compression strength, torsion strength and cantilever strength shall be as provided in the Guranteed technical particuras at Schedule- I

The bidder shall furnish the type test certificate of the post insulators from their manufacturer for reference & scrutiny.

## 4.0 TECHNICAL DETAILS:-

The H.G. Fuses shall have adjustable arcing horns made of solid copper rod having 8.23 mm dia. The horns shall be fitted with screwing devices with fly nuts for fixing and tightening the fuse wire. It shall have robust terminal connector of size 80mm x 50 mm x 8 mm made of copper casting ( 95% minimum copper composition) duly silver plated with two numbers of 12mm dia brass bolts and double nuts with flat brass washers. The connector should be capable of connecting crimp able conductor up to 232 Sq.mm. size (ACSR/

AAAC) with bimetallic solder less sockets .The H.G. Fuse Set shall be suitable for horizontal mounting on sub-station structures. All metal (ferrous) parts shall be galvanized and polished. Only post insulator (original cemented and not pin insulators shall be used for the H.G. Fuse Set.

## **5.0 DRAWING & LITERATURES:-**

Three copies of drawings of each item of 33KV & 11KV, 400Amp, 3 Pole H.G. Fuse shall be furnished along with the tender for reference. The details of construction and materials of different parts of the H.G Fuse shall clearly be indicated in the tender and illustrative pamphlet/ literature for the same shall be submitted along with the tender.

## **6.0 TESTS & TEST CERTIFICATE:-**

**6.1 Type Test:-** Certificates for the following type tests conducted within five years preceding to the date of opening of tender on a prototype set of H.G. Fuse in a Govt. Approved Testing Laboratory preferably at CPRI/ERDA shall be submitted along with the tender.

- i) Impulse voltage dry test
- ii) Power frequency voltage dry test
- iii) Power frequency voltage wet test
- iv) Temperature of resistance.
- v) Test to prove the capability of carrying the rated peak short circuit current and the rated short time current.
- vi) Mainly active load braking capacity test.
- vii) Transformer off-load breaking test.
- viii) Line charging breaking capacity test.
- ix) Operation tests.
- x) Mechanical endurance test.
- xi) Mechanical strength test for the post insulator as per IS:2544/1973, 5350 (Pt-II)/1970 & relevant IEC.
- xii) Test for galvanization of metal (ferrous) parts as per IS- 2633/1973.

## **6.2 Routine Tests:-**

The following routine tests shall have to be conducted on each sets.

- i) Power frequency voltage dry test.
- ii) Tests to prove satisfactory operation.
- iii) Dimension check.
- iv) Galvanisation test.



## 7.0 GUARANTEED TECHNICAL PARTICULARS:-

The bidders are required to furnish the guaranteed technical particulars at Schedules attached to this specification duly filled in along with the tender.

## 8.0 COMPLETENESS OF EQUIPMENT:-

Any fittings accessories or equipment which may not have been specifically mentioned in this specification but which are usually necessary in equipment of similar plant shall be deemed to be included in the specification and shall be supplied by the Bidder without extra charge. All plant and equipment shall be complete in all details whether such details are mentioned in the specification or not.

## 9.0 Schedule -I (GURANTEED TECHNICAL PARTICULARS FOR 400 AMP, 3 POLE, H.G. FUSES.)

Sl. No.	Particulars	Desired Values for		Bidder's Offer
		33 KV	11 KV	
1	Maker's name and country or origin	To be specified by the tenderder.		
2	Suitable for mounting	Horizontal only.		
3	Number of supporting post insulator per phase	4 nos. 22KV/24KV Post Insulator per phase as per ISS - 2544/ 1973	2 nos. 12KV Post Insulator per phase as per ISS -2544/ 1973	
4	Post Insulator			
(a)	Maker's name and country or orgin	To be specified by the tenderder.		
(b)	Type of cemeting	To be quoted original cemented only.		
(c)	One minute power frequency withstand voltage dry	95KV RMS	35KV RMS	

(d)	One minute power frequency withstand voltage wet.	75 KV RMS.	35KV RMS	
(e)	Visible discharge voltage	27KV RMS	9KV RMS	
(f)	Dry Flashover Voltage	To be specified by the tenderder.		
(g)	Power frequency puncture withstand voltage	1.3 times of actual dry flash over voltage.		
(h)	Impulse withstand voltage (switch in position)	170KV (peak)	75KV (peak)	
(l)	Creepage distance	380mm minimum. (actual creepage distance for which type test have been conducted is to be specified by the bidder )	230mm minimum. (actual creepage distance for which type test have been conducted is to be specified by the bidder )	
5	Impulse withstand voltage for positive and negative polarity (1.2/50 micro second wave)			
(a)	Across the isolating distance	195 KV (peak)	85KV (peak)	
(b)	To earth & between poles	170 KV (peak)	75 KV (peak)	
6	One minute power frequency withstand voltage			
(a)	Across the isolating distance	100 KV (RMS)	32 KV (RMS)	

(b)	To earth & between poles	75 KV (RMS)	28 KV (RMS)	
7	Rated normal current and rated frequency.	400 amps, 50 Hz , 3 Pole		
8	Operating Voltage	33 KV	11 KV	
9	Vertical clearance from top of insulator cap to mounting Channel	508 mm (minimum)	254 mm (minimum)	
10	Height of the riser for carrying the horns.	250mm from the cap (top) of insulator.	150mm from the cap (top) of insulator.	
11	Details of Arcing Horns	Copper rod having 8.32 mm dia Silver-plated provided with screwing arrangement for fixing use wire made of copper casting. (Total length 995mm). All the bolts, nuts and washers should be made out of brass.	Copper rod having 7.62 mm dia Silver-plated provided with screwing arrangement for fixing use wire made of copper casting. (Total length 635mm). All the bolts, nuts and washers should be made out of brass.	

12	Riser Unit (250mm height).  total	(a) The shape of connectors may be made of straight copper Flat of size adequate enough to carry a current density not less than 1.5 Amp/mm <sup>2</sup> . 2 Nos of 3/8" G.I. Bolts, double nuts, plain and spring washers and 2 nos. solder less bimetallic sockets per each connector suitable up to 232 mm <sup>2</sup> AAA conductor.	(a) The shape of connectors may be made of straight copper Flat of size adequate enough to carry a current density not less than 1.5 Amp/mm <sup>2</sup> . 2 Nos of 3/8" G.I. Bolts, double nuts, plain and spring washers and 2 nos. solder less bimetallic sockets per each connector suitable up to 100 mm <sup>2</sup> AAA conductor.	
		(b) 170mm height G.I. Riser made of 25mm nominal bore medium gauge G.I. Pipe welded with 2 nos. G.I. Flat of 35 x 5 mm at both ends fixed with 10mm dia stainless steel, bolts and nuts with flat stainless steel spring washers.	(b) 100mm height G.I. Riser made of 19mm nominal bore medium gauge G.I. Pipe welded with 2 nos. G.I. Flat of 30 x 5 mm at both ends fixed with 10mm dia stainless steel, bolts and nuts with flat stainless steel spring washers.	
13	Supporting Channels	100 x 50 x 6 mm M.S. Channel (galvanized)	75 x 40 x 6 mm M.S. Channel (galvanized)	
14	Galvanisation	All ferrous parts should be galvanized as per IS-2633/1972 & all non-ferrous part should be duly electroplated with silver.		
15	Weight of each pole (complete)	To be specified by the tenderder.		

**10.0 Schedule –II (GUARANTEED TECHNICAL PARTICULARS  
11 KV 200 Amp 3 Pole HG Fuse)**

<b>Sl. No.</b>	<b>Particulars</b>	<b>(Desired Value)</b>	<b>Values offered by the Bidder</b>
<b>1</b>	Name of the manufacturer and country of origin	To be specified by the bidder	
<b>2</b>	Operating voltage	11 KV	
<b>3</b>	No. of Insulators per Phase	2 no.s 12 KV Post Insulators per Phase	
<b>4</b>	Rated normal current and normal frequency	200 Amps. 50 Hz	
<b>5</b>	Vertical clearance from top of insulator cap to mounting channel	254 mm (minimum)	
<b>6</b>	Height of the riser for carrying the horns	150 mm from the cap (top) of insulator	
<b>7</b>	Post Insulator		
<b>(a)</b>	Name of the manufacturer and country of origin	To be specified by the bidder	
<b>(b)</b>	Type of cementing	To be quoted original cemented only	
<b>(c)</b>	One minute power frequency withstand voltage - Dry	35 KV RMS	
<b>(d)</b>	One minute power frequency withstand voltage – Wet	35 KV RMS	
<b>(e)</b>	Visible discharge voltage	9 KV RMS	
<b>(f)</b>	Dry Flashover voltage	To be specified by the bidder	
<b>(g)</b>	Power frequency puncture	1.3 times of actual dry	

	withstand voltage	flash over voltage	
<b>(h)</b>	Creepage distance	300 mm minimum (actual creepage distance for which type test has been conducted is to be specified by the bidder).	
<b>8</b>	Impulse withstand voltage (1.2/50 micro second wave positive & negative polarity)		
<b>(a)</b>	Across the isolating distance	85 KV (peak)	
<b>(b)</b>	To earth & between poles	75 KV (peak)	
<b>9</b>	One minute power frequency withstand voltage		
<b>(a)</b>	Across the isolating distance	32 KV (RMS)	
<b>(b)</b>	To earth & between poles	28 KV (RMS)	
<b>10</b>	Details of Arching Horns	10 Solid copper rod having 7.62 mm dia silver plated provided with screwing arrangement on the fuse carrier made of copper casting for fixing fuse wire. (Total length 63.5 mm). All the bolts, nuts and washers should be made out of brass	
<b>11</b>	Riser Unit (150 mm total height)	Riser cum connector made out of copper casting with minimum 95% copper composition) having riser	

		size 50 mm height x 30 mm width x 8 mm thickness and connector size 80x50x6 mm duly silver plated and machine finishing provided with 2 no.s 12 mm dia brass bolts & brass double nuts with flat brass washer and 2 no.s solderless bimetallic sockets per each connector suitable upto 80 mm <sup>2</sup> conductor	
12	Supporting Channels	12 75 x 40 x 6 mm MS Channel (Galvanized)	
13	Galvanization	All ferrous parts should be galvanized as per IS-2633/1972 & all non-ferrous parts should be duly electroplated with silver.	
14	Weight of each pole (complete)	To be specified by the bidder	
15	Sockets (Lugs)	Shall be tinned copper sholder less crimping type confirming to IS : 8309 & 8394 suitable for aluminium conductor. The cable lugs shall suit the type of terminals provided. The cable lug shall be of Dowel make.	
16	Detailed drawing submitted ?	Yes	





**TECHNICAL SPECIFICATIONS  
FOR  
CABLE TERMINATIONS AND JOINTING KITS**

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OF  
CABLE TERMINATIONS AND JOINTING KITS**

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# **TECHNICAL SPECIFICATIONS FOR HEAT SHRINKABLE CABLE JOINT KITS FOR CABLE TERMINATIONS AND JOINTS**

## **1.0 GENERAL:**

1.1 The term heat shrink refers to extruded or molded polymeric materials which are cross linked to develop elastic memory and supplied in expanded or deformed size or shape. The manufacturer of kits besides stating the properties of each component of the kit as indicated below and as per the detailed specifications should also state the source of origin of each component viz; whether locally manufactured or imported in raw material form and processed. The manufacturing activity carried out on each component should be stated. Also, in case the kit is assembled with components imported from two or more foreign suppliers, the manufacturers should give documentary proof supported by the foreign manufacturers confirming that the kit assembled utilizing components of different suppliers are guaranteed by them.

## **2.0 QUALIFYING EXPERIENCE:**

2.1. The kits should have satisfactory performance record in India in excess of 5 years supported with proof of customers having had satisfactory use of these kits in excess of 5 years.

## **3.0 HEAT SHRINKABLE MATERIAL:**

3.1. The heat shrinkable material component used in the joint shall have been produced in a systematic procedure as follows:

- a) The required materials shall be mixed and extruded into the required shape and then cross- linked by irradiation or any other appropriate chemical process. The components are then warmed and stretched by a predetermined amount and allowed to cool in the extruded shape. The cross-linking shall create a memory and when heated again, the same shall come back to its original shape at which it was cross-linked. Heat shrinkable tubes can be reduced to 30% of its expanded dimension by heating.
- b) The volume resistivity of the sleeves shall be  $10^8$  ohm-cm and the dielectric constant of around 15 to 30. The limiting temperature shall not be less than 100°C for longer duration and 250°C for one minute.

## **4.0 TYPE TEST REPORTS:**

The Joints and terminations should have been subjected to all the type tests and type test reports not later than 5 years on the day of Bid opening shall be furnished for verification.

## **5.0 ELECTRICAL CLEARANCES:**

The electrical clearances required for a Indoor/Outdoor termination and a straight through joint is shall be as per standards

## **6.0 COMPRESSION TYPE TUBULAR TERMINAL ENDS:**

The materials used in the terminals shall be Aluminum of grade 19501 conforming to IS 5082 - Specifications for wrought aluminum and aluminum alloys bars, rods, tubes and sections for electrical purposes. The finish inside the barrel shall either be suitably roughened throughout the crimping length of terminal end or provided with suitable greasebased compound with abrasive action. Edges and corners shall be free from burrs and sharp edges. The terminals shall meet the requirements of IS 8309 - Specification for Compression type tubular terminal ends for aluminum conductors of insulated cables.

## **7.0 JOINT KITS:**

The requirements contained in a typical joint Kit are as follows:

- a) Heat shrinkable or push-on or Tapex or cold shrinkable type clear insulating tubes
- b) Stress control tubing where necessary
- c) Ferrule insulating tubing for joints.
- d) Conductive cable break outs for terminations, non tracking, erosion and
- e) Weather resistant tubing both outer / inner
- f) Non tracking erosions and weather resistant outdoor sheds in case of terminations
- g) High permittivity mastic wedge Insulating mastic.
- h) Aluminum crimping lugs of ISI specification.
- i) Tinned copper braids
- j) Wrap around mechanical protection for joints.
- k) Cleaning solvents, abrasive strips.
- l) Plumbing metal.
- m) Binding wire etc. adequate in quantity and dimensions to meet the service and test conditions.
- n) The kit shall contain a leaflet consisting of detailed installation instructions and shall be properly packed with shelf life of over 3 years.

## **8.0 LIST OF MANUFACTURERS:**

- a) RECHEM
- b) FRONTECH
- c) 3M

The bidders can only offer the above manufacturer's equipments.

## ANNEXURE - I

### SPECIFICATIONS FOR MATERIAL PROPERTIES AND OTHER TECHNICAL REQUIREMENTS FOR HEAT SHRINKABLE CABLE TERMINATIONS AND JOINTS SUITABLE FOR 33 kV SCREENED CABLES/XLPE CABLES

#### 1.0 GENERAL:

The term heat shrink refers to extruded or molded polymeric materials which are cross linked to develop elastic memory and supplied in expanded or deformed size or shape. The subsequent heating results in shrinking down to original size and shape. The manufacturer of kits besides stating the properties of each component of the kit as indicated below and as per the detailed specifications given in **Enclosures-I(A), I(B) & I(C)** should also state the source of origin of each component viz; whether locally manufactured or imported in raw material form and processed. The manufacturing activity carried out on each component should be stated. Also, in case the kit is assembled with components imported from two or more foreign suppliers, the manufacturers should give documentary proof supported by the foreign manufacturers confirming that the kit assembled utilizing components of different suppliers are guaranteed by them.

#### 2.0 QUALIFYING EXPERIENCE:

The kits should have satisfactory performance record in India in excess of 5 years supported with proof of customers having had satisfactory use of these kits in excess of 5 years.

#### 3.0 PERFORMANCE TESTING AT CPRI, BANGALORE:

The successful contractor/bidder should undertake the testing of termination and jointing kits at CPRI or any Govt. laboratory. ~~in the presence of CESU Engineers as per the performance type test sequence given below. For this purpose, the kit shall be selected by CESU Engineers in the manufacturer's premises and sealed by the Engineer before taking it to CPRI, Bangalore.~~

Typical atmospheric conditions during the tests		
SI No	Particulars	Details
1	Amb. Temperature	Maximum 45 <sup>0</sup> C
		Minimum 10 <sup>0</sup> C
2	Atmospheric pressure	963 to 987 m. bar

3	Relative Humidity	50 – 90 %
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Test sequence				
SI No	Test Sequence		Test Voltage	Test results shall be as
	1	Impact a wedge shaped weight of 4 kg having a 90 <sup>0</sup> angle with a 2 mm radius shall be dropped freely 6 times from a height of 2.0M. On to the sample. The drops shall		
2	AC voltage withstand (IEC Pub 60)	1 min	35 kV	Shall withstand satisfactorily
3	Impulse voltage withstand test (IEC Pub 60 & 230)	10 positive and 10 negative 1.2/50 micro seconds between each conductor & the grounded sheath or screen	Indoor -75 kV	-do-
			Outdoor 95 kV	
4	Load Cycling	63 cycles, 5 hrs heating, 3hrs cooling conductor temperature screened : 75 <sup>0</sup> C	15 kV	-do-
5	Thermal short circuit	1 Sec. symmetrical fault with sheath temp. as per		-do-
6	Load Cycling	Repeat	15 kV	-do-
7	A/C voltage withstand	4 hrs	24 kV	-do-
8	Impulse voltage withstand	Repeat	Indoor -75 kV	-do-
			Outdoor 95 kV	

9	D/C voltage withstand	30 Min.	48 kV	-do-
10	Humidity indoor termination	Conductivity 800 M/h	7.5 kV	-do-
11	Dynamic short circuit (VDE 0278)	63 kA		-do-
12	Salt fog outdoor terminations	224 Kg/m <sup>3</sup>	7.5 kV	-do-

### ENCLOSURE – I (A)

#### MATERIAL SPECIFICATION FOR HEAT SHRINKABLE TUBING

Test	Test Method	Requirement				
		Non-Tracking Tubing	Stress Control Tubing	Ferrule insulating tubing	Clear insulating tubing	Inner Outer tubing for Joint
Tensile Strength	ISO 37	8 N/mm <sup>2</sup> Min.	14 N/mm <sup>2</sup> Min.	10 N/mm <sup>2</sup> Min.	12 N/mm <sup>2</sup> Min.	14 MPa Min.
Ultimate Elongation	ISO 37	300 % Min.	250 % Min.	300 % Min.	200 % Min.	500 % Min.
Accelerated Ageing 168 Hrs.	ISO 188					
- Tensile Strength	ISO 37	7.5 N/mm <sup>2</sup> Min.	13 N/mm <sup>2</sup> Min.	10 N/mm <sup>2</sup> Min.	12 N/mm <sup>2</sup> Min.	14 MPa Min.
- Ultimate Elongation	ISO 37	200 % Min.	130 % Min.	300 % Min.	200 % Min.	300 % Min.
Thermal Endurance	IEC 216	110° C Min.	90° C Min.	105° C Min.	110° C Min.	120° C Min.
Electric Strength	IEC 243	Wall Elec. Thkn. Strn. (Normal) KV/CM	-	Wall Elec. Thkn. Strn. (Normal)KV/C M	Wall Elec. Thkn. Strn. (Normal)KV/C M	100 kV/CM Min.



		3.0 mm. 100 Min.		3.0 mm. 100 Min.	*1.3 mm. 100 Min.	
Volume Resistivity	IEC 93	$1 \times 10^8$ OHM-CM Min.	$5 \times 10^{10}$ OHM-CM	$1 \times 10^{13}$ OHM-CM Min.	$1 \times 10^{16}$ OHM-CM Min.	$1 \times 10^{12}$ OHM-CM
Dielectric	IEC 250	5.0 Max.	15.0 Min.	5.0 Max.	3.5 Max.	5.0 Max.
Tracking and erosion resistance	ASTM D2303	No tracking erosion to top surface or flame failure after: 1 HR at 2.5 kV 1 HR at 2.75 kV 1 HR at 3.0 kV 20 Mins at 3.25kV	-	KA 3C		KA 1
Water absorption	ISO/R 62 Procedure A	1 % Max. AFT. 14 days at $(23 \pm 2)^\circ\text{C}$	1 % Max. AFT. 14 days at $(23 \pm 2)^\circ\text{C}$	1 % Max. AFT. 14 days at $(23 \pm 2)^\circ\text{C}$	0.5 % Max. AFT. 14 days at $(23 \pm 2)^\circ\text{C}$	0.2 % Max. AFT. 14 days at $(23 \pm 2)^\circ\text{C}$
Resistance to liquids	ISO 1817					
Transformer oil to VDE 0370 immersion & days						
Tensile Strength	ISO 37	5 N/mm <sup>2</sup> Min.	13 N/mm <sup>2</sup> Min.	7.5 N/mm <sup>2</sup> Min.	-	14 MPa Min.
Ultimate Elongation	ISO 37	250 % Min.	250 % Min.	250 % Min.	-	300 % Min.

<b>MATERIAL SPECIFICATION FOR HEAT SHRINKABLE MOULDED PARTS</b>				
SI No	Test	Test Method	Requirement	
			Sheds	Conductive Break out
1	Tensile Strength	ISO 37	8 N/mm <sup>2</sup>	9 N/mm <sup>2</sup>
2	Ultimate Elongation	ISO 37	300 % Minimum.	230%
3	Accelerated Ageing 168	ISO 188		
4	Tensile Strength	ISO 37	7.5 N/mm <sup>2</sup> Minimum.	9 N/mm <sup>2</sup> Minimum.
5	Ultimate Elongation	ISO 37	200 % Minimum.	150 % Minimum.
6	Thermal Endurance	IEC 216	110°C Minimum.	105°C Minimum.
7	Electric Strength	IEC 243	Wall Elec. Thkn. Strn. (Normal) KV/CM	-
			<3.0 100 mm. Minimum	
8	Volume Resistivity	IEC 93	1 × 10 <sup>13</sup> OHM-CM Minimum	200 OHM-CM Max.
9	Dielectric constant	IEC 250	5.0 Maximum.	-
10	Tracking and erosion resistance	ASTM D2303	No tracking erosion to top surface or flame failure after: 1 HR at 2.5 kV	-
11	Water absorption	ISO/R 62 Procedure A	1 % Max. AFTER. 14 days at	1 % Max. AFTER. 14
12	Resistance to liquids	ISO 1817		
13	Transformer oil to VDE 0370 immersion & days at (23 ± 2)°C			
14	Tensile Strength	ISO 37	5 N/mm <sup>2</sup> Minimum.	7.5 N/mm <sup>2</sup> Minimum.
	Ultimate Elongation	ISO 37	250 % Minimum.	150 % Minimum.

### ENCLOSURE- I(C)

MATERIAL SPECIFICATION FOR HEAT SHRINKABLE ADHESIVE/SEALANTS			
Test	Test Method	Requirement	
		Black Insulator Mastic	Sealant break-out and sheds
Softening Point	ASTM E28	$(115 \pm 10)^{\circ} \text{C}$	
Electric Strength	IEC 243	130 kV/CM Min.	80 kV/CM Min.
Volume resistivity	IEC 93	$1 \times 10^{14} \text{ OHM-CM}$  Min.	
Water absorption	ISO/R 62 Procedure A	1 % Max. AFT. 1 day  at $(23 \pm 2)^{\circ} \text{C}$	1 % Max. AFT. 1 day at  $(23 \pm 2)^{\circ} \text{C}$
Corrosive effect 16 Hrs. at $121^{\circ} \text{C}$	ASTM D2671 Method-B	No corrosion	
Adhesive peel strength substrate 2/1	as detailed in master Spec.	-	

			Below- 30 <sup>0</sup> C
NTR/ NTR			25N/25 mm Min.
NTR/ CON			20N/25 mm Min.
NTR/ AL			20N/25 mm Min.
NTR/ Pb			20N/25 mm Min.
T.E.R.T	ASTM D2303	-	No tracking erosion to top surface or flame failure after : 1 HR at 2.0 kV

**ANNEXURE – I(D)**  
**CLASSIFICATION OF SOIL STRATA**

**1.00 Ordinary Soil:**

This shall comprise of vegetable or organic soil, turf, sand, sandy soil, silt, loam, clay, mud, red earth, suede, peat, black cotton soil, soft shale, loose murrum, mud debris, concrete below ground level, a mixture of all these and similar material which yields to the ordinary application of pick, shovel, rake or other ordinary digging implement. Removal of gravel or any other modular material having diameter in any one direction not exceeding 75 mm, such occurring strata shall be deemed to be covered under this category.

**2.00 Hard Soil:**

This shall include :

- 1) Stiff heavy clay, hard shale or compact murrum requiring grifting tool or pick or both and shovel closely applied.
  
- 2) Gravel, soft laterite, kankar and cobble stone having maximum diameter in any one direction between 75 mm and 300 mm.
  
- 3) Soliding of road paths, etc., and hard core.
  
- 4) Macadam surfaces such as water bound and bitumen/tar bound.
  
- 5) Lime concrete, stone masonry in lime/cement mortar below ground level.
  
- 6) Soft conglomerate, where the stones may be detached from the matrix with picks.
  
- 7) Generally any material which requires the close application of picks or sacrificers to loosen and not affording resistance to digging greater than hardest of any soil mentioned in item (1) to (6) above.

### 3.00 Ordinary Rock:

- 1) Ordinary rock comprising of lime stone, sand stone, hard laterite, fissured rock, conglomerate or other soft or disintegrated rock which may be quarried or split with crow bars.
- 2) Unreinforced cement concrete which may be broken up with crow bars or picks and stone masonry in cement mortar below ground level.
- 3) Boulders which do not require blasting having maximum diameter in any direction of more than 300 mm found lying loose on the surface or embedded in river bed, soil, talus slope wash and terrace material of dissimilar origin.

NOTE : Hard laterite does not require blasting. It is to be classified under ordinary rock which does not require blasting.

### 4.00 Hard Rock:

This shall comprise:

- 1) Any rock or cement concrete or RCC for the excavation of which the use of mechanical plant or blasting is required.

**TECHNICAL SPECIFICAION  
FOR  
EARTHING AND EARTHING COIL**

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OF  
EARTHING AND EARTHING COIL

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## **SUB-STATION EARTHING**

### **PART - A**

#### **1.0 EARTHING:**

Earth mat design to be carried out referring to the **IEEE-Std 81** before implementation of the same. Design shall be based on the soil resistivity. The measurement of the soil resistivity is to be taken before the representative of Owner by using a latest 4-port Digital Earth Tester duly calibrated having validity period. The design of Earth mat to be furnished by the Contractor for approval of the Owner.

The material offered shall be procured from short listed vendor at **E-23** and shall have been successfully Type Tested during last five years on the date of bid opening. The Type Test reports shall be submitted along with the bid.

#### **1.1 GUIDE LINE:**

The Earth mat conductor shall be of 75x10 mm GI flats and it shall be laid in both the directions in the Switchyard and the gap between each conductor shall not be more than 2(two) Mtr. However, this gap may be further reduced depending on the design.

Earth risers should be of 50x6 mm GI flats. All equipment & metal parts of the Sub-station should be connected with main earth grid by using 50x6 GI flats at two different places. The main earth grid should be laid not less than 600 mm below the finished ground level. The lap welding should not less than 150 mm. The welding of joints should be done after removal of Zinc by using Blow lamps. Welding should be done in all four sides and should be double layer continuous. Before taking up the second layer welding the deposited flux should be removed. During welding the two flats should be tightened properly by using 'C' clamps. Immediately after welding two layers of anti-corrosive paints should be painted over the welded portion along with two coats of Black bituminous paints. Before back filling of earth trenches the welded portion should be covered by wrapping with bituminous tape properly and also jointing portion should be covered with PCC (1:2:4) mix. The backfilling of earth pits and trenches should be done with powered loam soil mixed with Bentonite powder (10:1) mix.

All equipment, steel structures etc. should be connected with main earth mat at two points and with separate risers from the main earth mat. All equipment, structures, spikes (if any) should be connected individually with individual Pipe electrodes and again should be connected with main earth grid at two

separate places. The Neutral of Power Transformer should be connected with two separate Pipe electrodes and again connected with main earth electrodes at two separate places. The separation distance between each Pipe electrodes should not be less than 3 mts. The back filling of Pipe electrodes should be done in layer of Charcoal, loam soil mixed with Bentonite powder. The value of earth resistance should be less than 0.5 ohm with above arrangement. Where there is possibility of not achieving the earth resistance value, special type of earthing device (chemically treated) can also be used to achieve the desired value.

There should be a closely spaced earth grid of size 1.5 mts x 1.5mts by using 75 mm x 10mm GI flat, with 0.3 mts spacing both ways below the mechanism boxes of each Isolators & AB switches. In Sub-station the diameter of Pipe electrode should not be less than 50 mm dia, heavy gauge GI Pipe (perforated). **The Flange (50x6) mm GI flat should be welded in all sides with Pipe electrode.** In each face of Flange there should be two nos. of 17.5 mm hole to accommodate 16 mm GI Bolt & nut with spring washer.

The fencing of the Switchyard should not directly be connected with main earth mat grid. There should be a separate earth mat by running 75x10 mm GI flat at 2 mts away from outside the fence and should be connected rigidly with the fence at an interval of 5 mts. In addition, another GI Flat of 50x6 mm should run continuously over the fencing and proper welding is also to be made. There should be one 50x6 mm earth flat run over the cable rack and should be connected with main earth mat grid at an interval of 5 mts . The jointing portion of earth flats over the ground should be painted with two coats of Anti-corrosive paints and two coats of good quality of Aluminium paints (Berger/Asian paints).

Provision of watering to earth pits shall have to be provided by using conduit pipe arrangement. The pipes are be connected to the water source provided in the S/s. Each handles of Isolators / AB switches etc should be connected with earth mat grid by using flexible Tinned Copper earth bonds (25mm x 5mm through net). In each earth switches 2(two) nos. flexible earth bonds should be provided. Each earth pits having pipe electrodes should be provided 250 mm Brick wall chambers duly plastered on all the side with RCC cover Slab. The size of the chamber shall be 450x400x400mm.

## **2.0 G.I. Flat (75x 10 mm) & G.I.Flat (50 x 6 mm)**

The specification covers supply and testing of Galvanized Steel flat for Earthing arrangements.

## 2.1. APPLICABLE STANDARDS:

Materials shall conform to the latest applicable Indian standards / International standards.

Sl. No.	Standard No.	Title
1 M.S. Flat	IS:2062 Grade 'A' Quality	Specification for M.S. Channel and
2	IS:2062	Chemical and Physical Composition of material
3	IS:1852	Rolling and Cutting Tolerances for Hot Rolled Steel products

## 2.2 . INSPECTION AND TEST CERTIFICATE

The purchaser's representatives shall be entitled at all reasonable time during manufacture to inspect, examine and test at the bidder's premises, the materials and workmanship of the steel section to be supplied. As soon as the steel section are ready for testing , the bidder's shall intimate the purchaser well in advance, so that action may be taken for getting the material inspected. The material shall not be dispatched unless waiver of inspection is obtained or inspected by the purchaser's authorized representative. The routine & acceptance tests shall be in accordance with the latest version of the relevant Indian Standard.

All conductors buried in earth or in concrete or above the ground level shall be galvanized steel. Galvanized steel shall be subject to four one minute dips in copper sulphate solution as per IS:2633/1922).

The materials to be supplied will be subject to inspection and approval by the purchaser's representatives before dispatch unless otherwise waived. Inspection before dispatch shall not, however, relieve the Contractor of his responsibility to supply the steel section strictly in accordance with the ISS.

The representative of Purchaser shall pick up samples at random from the GI Flats offered for carrying out Routine tests as per specified IS. The

representative shall make visual inspection on each & every GI flats. **The purchaser reserves the right to reject the material if the same is found defective at destination.**

### 2.3. METHOD OF GALVANISING:

<u>Sl. No.</u>	<u>Tests</u>	<u>For GI Flat</u>
1	Dip test	6 dips of 1 min each
2	Mass of Zinc coating	610 gram/sq.m minimum

Pre dispatch inspection shall be performed to witness following tests:

- i) Freedom from defects,
- ii) Verification of dimensions
- iii) Galvanization tests
- iv) Mechanical tests
- v) Chemical composition tests

These tests are to be performed and certified at Govt. recognized laboratory. MS flat shall conform to IS 2062 & its latest amendments for steel & Galvanization as per IS 4759 & its Latest amendments.

The flat shall be coated with Zn 98 Zinc grade.

The minimum Zinc coating shall be 610 gm/sqm for thickness more than 5 mm and 460 gm/sqm for item thickness less than 5 mm.

### 3.0 Earth Electrode (50mm Dia. GI having gauge perforated pipe as per ISS)

#### 3.1. Scope:-

This specification provides for Supply of Earthing Device (**Heavy Duty**) (50x3000 mm), as per enclosed Drawing.

#### 3.2. APPLICABLE STANDARDS:-

The Earthing Device must be made out of 50 mm (Heavy Gauge- No minus Tolerance is allowed on Wall thickness) Hot Dip G.I. Pipe (as per IS: - 1239,m Part-1, 1990 of reputed Make – i.e. **TATA / Jindal**) & 3.3 mtrs length tapered finished smooth at one end for a length of 75 mm & Clamp at the other end.

Staggered drills hole of 12mm Dia. at an interval of 150mm shall be made before galvanization.

The GI Earthing Clamp/ Strip (C- Clamp Type) is to be of 50mm width, 6mm thickness & flange length of 65 mm in each side. This should be suitable for termination of 4 nos. of GI Flat earth electrodes. The Clamp/ Strip & Earthing pipe after fabrication will be hot dip galvanized confirming to IS: 2629/85 with latest amendments. The clamp shall have two holes in both sides suitable for 16 mm GI Bolts & Nuts. There shall be provision of funnel for pouring water through pipes. The height of the funnel shall be such that the watering will be better. Provision of reduced of GI pipe to be converted to the main GI earth pipe & on the top of the funnel is to be provided.

**PART – B**

**TECHNICAL SPECIFICATION  
FOR  
EARTHING COIL**

**EARHTING COIL**  
**TECHNICAL SPECIFICATION**

**PART - B**

**1.0. Qualification Criteria of Manufacturer:-**

The material offered shall be procured from a vendor who must have at least three years experience in manufacturing of the sam. The materials shall have been successfully type tested during last five years on the date of bid opening. The Type Test reports shall be submitted along with the bid.

**1.1. SCOPE**

The specification covers design, manufacture, testing for use in earthing of the HT & LT poles.

**2.0. GENERAL REQUIREMENTS**

Earthing coils shall be fabricated from soft GI Wire Hot Dip Galvanized. The Hot Dip galvanized wire shall have clean surface and shall be free from paint enamel or any other poor conducting material. The coil shall be made as per REC constructions standard.

The Hot Dip galvanizing shall conform to IS: 2629/1966, 2633/1972 and 4826/1969 with latest amendments.

**3.0. TESTS**

**I Galvanizing Tests**

Minimum Mass of Zinc

On GI Wire used 280 cm/m<sup>2</sup>

After Coiling-266 gm/m<sup>2</sup>.The certificate from recognized laboratory shall be submitted towards mas of zinc.

**II Dip Test**

Dip test shall stand 3 dips of 1 minute and one dip of ½ minute before coiling and 4 dips of 1 minute after coiling as per IS: 4826/1979

### III Adhesion Test

As per ISS 4826 – 1979.

#### 4.0. DIMENSIONAL REQUIREMENT

Nominal dia of GI Wire -4 mm (Tolerance±2.5%)  
 Minimum no. of turns – 115 Nos.  
 External dia of Coil (Min) – 50 mm  
 Length of Coil (Min) – 460 mm  
 Free length of GI Wire at one end coil (Min.) – 2500 mm  
 Minimum length of wire to be grounded during installation -1000 mm.  
 The turns should be closely bound. Weight of one finished Earthing Coils (min.) – 1.850 Kg.

#### 5.0

#### EARHTING COIL GUARANTEED TECHNICAL PARTICULARS (To be submitted along with Offer)

Sl. No.	GENERAL TECHNICAL PARTICULARS	Bidder's Offer
1	Nominal diameter of wire	
2	No. of turns	
3	External dia of Coil	
4	Length of Coil	
5	Mass of Zinc	
6	Total weight of Coil	
7	Whether drawing enclosed (yes)	

#### 6.0. EXTENSION POLE

Pole with pole extension arrangement up to two **to three** meters (in case of 33 KV new **Mini base** GI tower structure) shall be used at low ground level locations for maintaining ground clearance and for road crossings for HT Lines.

#### 7.0 PROVISION OF GUYS/STRUT POLES TO SUPPORTS

7.0.1 The arrangement for guys shall be made wherever necessary. Strut poles/flying guys wherever required shall be installed on various pole locations



as per REC construction standards. In order to avoid guys/ Strut self supported GI poles/ structures may be used.

**7.0.2** In this work anchor type guy sets are to be used. These guys shall be provided at following locations where guys are damaged or not provided.

- (i) Angle locations
- (ii) Dead end locations
- (iii) T-off points
- (iv) Steep gradient locations.
- (v) Double Pole, & four pole

The stay rod should be placed in a position so that the angle of rod with the vertical face of the pit is  $30^{\circ}$  to  $45^{\circ}$  as the case may be maximum movement for tightening or loosening.

**7.0.3** If the guy wire proves to be hazardous, it should be protected with suitable asbestos pipe filled with concrete of about 2 m length above the ground level, painted with white and black strips so that, it may be visible at night.

**7.0.4** The guy insulator should have a minimum vertical clearance of 3.5 mtr from the ground.

# **SPECIFICATION FOR LINE & ERECTION**

**TECHNICAL SPECIFICATION FOR CONSTRUCTION OF  
33 KV LINES AND 11KV LINES**

**1.0 GENERAL:** The work covered by this Specification is for 33kV and/or 11 kV distribution lines as specified herein. Preliminary route alignment in respect of the proposed 33KV & 11KV transmission lines has been fixed by the Owner subject to alteration of places due to way leave or other constraints. The Right of way shall be solved by the contractor and all expenses there of shall be borne by him. However, OWNER shall render all helps in co-ordination with law and order department for solving the same. Involvement of Forest land should be restricted as far as possible.

**2.0 SURVEY (detail survey, spotting of Poles & estimating of quantities ):**

2.1 Preliminary investigations have been made. The topography of all 33 kV lines and 11kV lines of more than 5 km length are enclosed in the specification as **Annexures.**

Walk over survey, detailed survey shall have to be carried out to confirm the Route alignment by the contractor for 33 KV, 11 KV lines. If the line is passing in any Municipal/ NAC areas permission from local bodies has to be obtained prior to execution of work. Suitable distance from the side of the road has to be made towards placement of line poles.

2.2 Provisional quantities/numbers of different types of tower structures/Joist poles/PSC poles have been estimated and indicated in the BOQ Schedule given. However final quantities for work shall be as determined by the successful bidder, on completion of the detail survey, preparation of route profile drawing and designing of the different types of tower structures/Joist poles/PSC poles as elaborated in the specification and scope of work.

**2.3** The contractor shall undertake detailed survey on the basis of the tentative alignment fixed by the Owner. The said preliminary alignment may, however, change in the interest of economy to avoid forest and hazards in work. While surveying the alternative route the following points shall be taken care by the contractor.

- (a) The line is as near as possible to the available roads in the area.
- (b) The route is straight and short as far as possible.
- (c) Good farming areas, religious places, forest, civil and defense installations, aerodromes, public and private premises, ponds, tanks, lakes, gardens, and plantations are avoided as far as practicable.
- (d) The line should be far away from telecommunication lines as reasonably possible. Parallelism with these lines shall be avoided as far as practicable.
- (e) Crossing with permanent objects are minimum but where unavoidable preferably at right angles.
- (f) Difficult and unsafe approaches are avoided.
- (g) The survey shall be conducted along the approved alignment only.
- (h) For river crossing/ Crossing of Nallas : Taking levels at 5 meter interval on bank of river and at 20 meter interval at bed of river so far as to show the true profile of the ground and river bed railway/road bridge, road The levels shall be taken at least 100 m. on either side of the crossing alignment. Both longitudinal and cross sectional shall be drawn preferably to a scale of 1:2000 at horizontal and 1:200 vertical.

After completing the detailed survey, the contractor shall submit the final profile and pole schedule (with no. of stay or strut) for final approval of the Owner. To facilitate checking of the alignment, suitable reference marks shall be provided. For this purpose, concrete pillars of suitable sizes shall be planted at all angle

locations and suitable wooden/iron pegs shall be driven firmly at the intermediate points. The contractor shall quote his rate covering these involved jobs.

## **2.4 Optimization of Pole Location**

### **2.4.1 Pole Spotting**

To optimize the line length, the contractor shall spot the poles in such a way so that the line is as close as possible to the straight line drawn between the start & end point of the line.

**2.4.2 Road Crossings:-** At all road crossings, the **double tension hardware fittings** should be used. There should absolutely no joints in the conductors in all road, power line and all other major crossing. The ground clearance from the road surfaces under maximum sag condition shall be not less than 8.5mtr over roads. In National High way the minimum height of guarding at the maximum sagging point should be less than 8.5 mts.

**2.4.3 Railway Crossings-** The railway crossing overhead or underground shall be carried out in the manner as approved & prescribed by the railway authorities from time to time.

The crossing shall normally be at right angle to the railway track. In case crossing is required to be done through underground cable, **cost of the cable including laying and other accessories shall be in the scope of the contractor.**

The crossing shall be done as per Rly Guide lines. During detailed engineering, the contractor shall submit his proposed arrangement for each railway crossing to the owner. The approval for crossing railway track shall be obtained by the owner from the Railway Authority.

### **2.4.4 Power Line Crossings-**

Where the line is to cross over another line of the same voltage or lower voltage, provisions to prevent the possibility of their coming into contact with each shall be made in accordance with the Indian Electricity Rules.

## **2.5 Details En-route**

After survey and finalization of route, the contractor shall submit detailed route map for each line. This would be including following details:

All poles on both sides of all the crossings shall be tension poles i.e. disc type insulators shall be used on these poles. At all the crossing described above the contractor shall use protective guarding as per REC Construction Standard A-1 to fulfill statutory requirements for 11 kV & 33 KV trunks & main spur line. 11kV & 33 KV branch spur line, being in the village, protective guarding shall be used wherever it will be required.

Clearance from Ground, Building, Trees etc. – Clearance from ground, buildings, trees and telephone lines shall be provided in conformity with the Indian Electricity Rules, 1956 as amended up to date. The vendor shall select the height of the poles in order to achieve the prescribed electrical clearances.

## **2.5. Final Schedule**

The final schedule including Bill of quantity indicating location of poles specifically marking locations of failure containment pole/structure, line tapping points; angle of deviation at various tension pole locations, all type of crossings and other details shall be submitted for the approval of the owner. After approval, the contractor shall submit six more sets of the approved documents along with one soft copy in CD to OWNER for record purpose.

## **3.0 CHECK SURVEY**

The contractor shall undertake the check survey during execution on the basis of the alignment profile drawing and tower schedule approved by the Owner. If during check survey necessity arises for minor change in route to eliminate way leave or other unavoidable constraints, the contractor may change the said alignment after obtaining prior approval from the Owner

#### **4.0 POLE FIXTURE AND ACCESSORIES**

##### **4.1 Danger Boards**

The vendor shall provide & install danger plates on all 33kv, 11 kV DP structures , H pole structures and towers. The danger plates shall conform to REC specification No. 57/1993.

##### **4.2 Anti-climbing Devices**

The vendor shall provide and install anti-climbing device on all 33kv and 11 kV DP structures, towers and at all poles as per CEA guide line. This shall be done with G.I. Barbed wire or modified spikes. The barbed wire shall conform to IS-278 (Grade A1). The barbed wires shall be given chromatin dip as per procedure laid down in IS: 1340.

##### **4.3 Fittings Common to all Line**

Pin Insulator Binding: The contractor shall use AL. Binding wire for binding shall be as per REC Construction Standards No. C-5 or better thereof.

Mid Span Compression Joint & Repair Sleeves: The contractor shall supply & install the Mid Span Compression Joint and Repair Sleeves as per IS: 2121 (Part II).

Guy/Stay wire Clamp: The contractor shall supply & install Guy/Stay wire Clamp as per REC Construction Standard G-1 or better..

##### **4.4 Stay/Guy Sets**

**a)** The Stay/Guys shall be used at the following pole locations;

At all the tapping points & dead end poles

At all the points as per REC construction dwg. No. A-10 ( for the diversion angle of 10-60 degree)

Both side poles at all the crossing for road, nallaha, railway crossings etc.

**b)** The arrangement and number of stay sets to be installed on different pole structures shall be as per REC Construction Standards no. A-23 to A-27, G-5 & G-8. However, this shall be decided finally during erection, as per the advice of Engineer.

**c)** The stay set to be installed complete in all respect and would broadly consist of following items:

7/10 SWG G.I. Stay wire for 11 kV lines and ~~7/12 SWG for LT line~~ as per REC Specification No.46/1986 Stay Insulator type A for LT line and type C for 11 kV line as per REC Specification No. 21/1981, Turn Buckle. Anchor rod and plate (Hot Dipped galvanized). Thimbles and Guy Grip Complete stay set shall be as per REC Construction Standards no. G-1. The stay clamp is envisaged as GS structure along with other clamps brackets etc.

#### **4.5. Erection of stay sets**

The contractor shall install the stay set complete in all respect. This includes excavation of pit in all kinds of soil with PCC in the ratio 1:2:4 as specified which shall be placed in the bottom of the pit.

The rest (upper half) of the pit shall be filled with excavated soil duly compacted layer by layer. An angle between 30 to 45 degrees shall be maintained between stay wire and the pole. The stay wire shall be used with a stay insulator at a height of 5 mts. above ground level with F.I. turn buckle.



## **5.0. Stringing and Installation of Line with Conductors.**

### **5.1 General**

The scope of erection work shall include the cost of all labour, tools and plants such as tension stringing equipment and all other incidental expenses in connection with erection and stringing work. The Bidders shall indicate in the offer the sets of stringing equipment he would deploy exclusively for work under each package.

The stringing equipments shall be of sufficient capacity to string AAA conductor or ACSR conductor.

The Contractor shall be responsible for transportation to site of all the materials to be provided by the Contractor as well as proper storage, insurance etc. at his own cost, till such time the erected line is taken over by the owner.

Contractor shall set up required number of stores along the line and the exact location of such stores shall be discussed and agreed upon with the owner.

### **5.2 Insulator Fixing**

Pin insulators shall be used on all poles while strain insulators shall be used on all angle & dead end poles. Special type Pin Insulators should be used for conductors more than 100 mm<sup>2</sup>. In coastal districts of Balasore, Bhadrak, Jajpur, Kendrapara, Jagatsinghpur, Cuttack, Khurdha, Puri and Ganjam polymer insulators shall be used. Damaged insulators and fittings, if any, shall not be used. Prior to fixing, all insulators shall be cleaned in a manner that shall not spoil, injure or scratch the surface of the insulator, but in no case shall any oil be used for this purpose. Torque wrench shall be used for fixing various line materials and components, such as suspension clamp for conductor, whenever recommended by the manufacturer of the same.

### **5.3 Running Out of the Conductors**

The contractor shall be entirely responsible for any damage to the pole or conductors during stringing. The conductors shall be run out of the drums from the top in order to avoid damage to conductor

A suitable braking device shall be provided to avoid damaging, loose running out and kinking of the conductors. Care shall be taken to ensure that the conductor does not touch and rub against the ground or objects, which could scratch or damage the strands.

The sequence of running out shall be from the top to down i.e. the top conductor shall be run out first, followed in succession by the side conductors. Unbalanced loads on poles shall be avoided as far as possible.

Wherever applicable, inner phase off-line conductors shall be strung before the stringing of the outer phases is taken up.

When lines being erected run parallel to existing energized power lines, the Contractor shall take adequate safety precautions to protect personnel from the potentially dangerous voltage build up due to electromagnetic and electrostatic coupling in the pulling wire, conductors and earth wire during stringing operations.

The Contractor shall also take adequate safety precautions to protect personnel from potentially dangerous voltage build up due to distant electrical storms or any other reason.

### **5.4 Repairs to Conductors**

The conductor shall be continuously observed for loose or broken strands or any other damage during the running out operations. Repair to conductors, if

necessary, shall be carried out with repair sleeves and not more than one repair sleeve will be used in one span.

Repairing of the conductor surface shall be carried out free of cost only in case of minor damage, scuff marks, etc. The final conductor surface shall be clean, smooth and free from projections, sharp points, cuts, abrasions etc. After compression the sharp edges must be smoothed by filing.

The Contractor shall be entirely responsible for any damage to the poles, insulators etc during stringing.

### **5.5 Stringing of Conductor**

The stringing of the conductor shall be done by the standard stringing method. The Bidder shall submit complete details of the **stringing method** for owner's approval. Conductors shall not be allowed to hang in the stringing blocks for more than 96 hours before being pulled to the specified sag.

Derricks/ scaffoldings or other equivalent methods shall be used to ensure that normal services are not interrupted and any property is not damaged during stringing operations for roads, telecommunication lines, power lines and railway lines. However, shut-down shall be obtained when working at crossings of overhead power lines. The contractor shall make specific request for the same to the owner.

### **5.6 Jointing**

When approaching the end of a drum length at least three coils shall be left in place when the stringing operations are stopped. These coils are to be removed carefully, and if another length is required to be run out, a joint shall be made as per the recommendations of the conductor manufacturer.

Conductor splices shall not crack or otherwise be susceptible to damage during stringing operation. The Contractor shall use only such equipment/methods during conductor stringing which ensures complete compliance in this regard.

All the joints on the conductor shall be of compression type, in accordance with the recommendations of the manufacturer, for which all necessary tools and equipment like compressors, dies etc., shall be arranged by the contractor. Each part of the joint shall be cleaned by wire brush till it is free of rust or dirt, etc. This shall be properly greased with anti-corrosive compound if recommended by the manufacturer, before the final compression is carried out with the compressors.

All the joints or splices shall be made at least 30 meters away from the pole. No joints or splices shall be made in spans crossing over main roads, railway line and Small River spans. Not more than one joint per conductor per span shall be allowed. The compression type fittings shall be of the self centering type or care shall be taken to mark the conductors to indicate when the fitting is centered properly.

During compression or splicing operation, the conductor shall be handled in such a manner as to prevent lateral or vertical bearing against the dies. After compressing the joint, the Aluminium sleeve shall have all corners rounded; burrs and sharp edges removed and smoothed.

To avoid any damage to the joint, the contractor shall use a suitable protector for mid span compression joints in case they are to be passed over pulley blocks/aerial rollers. The pulley groove size shall be such that the joint along with protection can be passed over it smoothly.

In case AAAC is used each press should overlap 25% of the previous press.

### **5.7 Tensioning and Sagging Operations:**

The tensioning and sagging shall be done in accordance with the approved stringing charts or sag tables.

The sag shall be checked in the first and the last section span for sections up to eight spans and in one additional intermediate span for sections with more than eight spans and sagging operations shall be carried out in calm weather when rapid changes in temperature are not likely to occur.

### **5.8 Clipping In**

Clipping of the conductors into position shall be done in accordance with the manufacturer's recommendations. Jumpers at section and angle towers shall be formed to parabolic shape to ensure maximum clearance requirements. Pilot pin insulator shall be used, if found necessary, to restrict jumper swing & to ensure proper clearance to design values.

Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and sprung into position.

### **5.9 Fixing of Conductors Accessories**

Conductor accessories supplied by the Contractor shall be installed by the Contractor as per the design requirements and manufacturer's instructions. While installing the conductor accessories, proper care shall be taken to ensure that the surfaces are clean and smooth and that no damage occurs to any part of the accessories or of the conductors.

### **5.10 Replacement:**

If any replacements are to be effected after stringing and tensioning or during maintenance e.g. replacement of cross arms, the conductor shall be suitably tied to the pole at tension points or transferred to suitable roller pulleys at suspension points.

#### **5.11 Normal Span length**

1. Normally the span length is to be kept 50 mtr, But where there is way leaf problem, the span length can be modified by maintaining minimum ground clearance. (The span length shall be applicable for both 33KV& 11 KV lines.)
2. Three cut points have been considered in every km.

### **6.0 WAY-LEAVE AND TREE CUTTING**

Way-leave permission which may be required by the contractor shall be arranged at his cost. While submitting final-survey report for approval, proposals for way-leave right of way shall be submitted by the contractor. Owner may extend help to get the permission within a reasonable time as mutually agreed upon for which due notice shall be given by the contractor in such a way so that obtaining permission from appropriate authority do not hinder the continued and smooth progress of the work.

The Owner shall not be held responsible for any claim on account of damage done by the contractor or his personnel to trees, crops and other properties.

The contractor shall take necessary precaution to avoid damage to any ripe and partially grown crops and in the case of unavoidable damage, the Owner shall be informed and necessary compensation shall be paid by the contractor.

All the documents required for application to the statutory authorities must be prepared by the contractor & submitted to the Owner for submission of the application towards approval of Railway Crossing etc. However, the responsibilities lie with the contractor to get the clearance.

Trimming of tree branches or cutting of a few trees en-route during survey is within the scope of survey to be done by the contractor. Contractor shall arrange for necessary way-leave and compensation in this regard. During erection of the line, compensation for tree cutting, damage caused to crops, actual cutting and falling of the trees including way-leave permission for such route clearance shall be arranged by the contractor at his cost. The contractor will identify the number of trees and detail of obstructions to be removed for erection of the line and intimate the Owner well in advance in case of any help. Other related works like construction of temporary approach roads, etc. as required, shall be done by the contractor and the same will lie within the scope of contractor's work and such cost shall be considered to be included in the rates quoted by him.

#### **7.0 SUB-SOIL INVESTIGATION** (In case of river crossing locations/other locations where PILLING may be required)

To ascertain soil parameters in locations where higher tower either 220KV (UR+6) or 132 KV type tower (PC+6) of OPTCL design, will be required in order to get adequate ground clearance, the contractor shall carry out sub-soil investigation through reputed soil consultant as approved by the Owner.

#### **7.1 SCOPE OF WORK**

The scope of sub-soil investigation covers execution of complete soil exploration for the transmission line under this contract including boring, drilling, collection of

undisturbed soil sample where possible, otherwise disturbed samples, conducting laboratory test of soil samples to find out the various parameters as detailed in this specification and submission of detailed reports in 6 copies along with specific recommendation regarding suitable type of foundation for each bore-hole along with recommendation for soil improvement where necessary.

## **7.2 TEST BORING**

The boring shall be done at the major locations / crossing of special towers. However, it is desirable that all special towers in river X-ing spans, sub-soil investigation bore-hole will be required.

The test boring through different layers of all kinds of soil shall have to be carried out by the contractor through the approved soil consultant as briefed hereunder.

- (a) Method of boring, selection of sampling tubes, sampling, recording of boring, protection, handling, leveling of samples shall be done as specified in IS: 1892/1977, The contractor/consultant shall furnish in the soil report the, the equipment and method of boring adopted.
- (b) Depth of boring below ground level shall be normally 15 Mts to 25 Mts.,in river crossing locations.
- (c) Undisturbed soil samples shall be obtained for the initial 4M depths at every 1.5M interval and at change of strata. After these initial 4M depths, samples shall be obtained preferably at every 3M or where there is a change of strata, or as advised by the Owner.
- (d) In case collection of undisturbed samples becomes difficult/impossible detailed soil testing on remolded soil samples is to be considered and reported in the soil report.



- (e) Standard penetration test as per IS: 2131 with latest amendment shall have to be conducted in different strata and recorded properly.
- (f) The ground water table shall be recorded during boring operation and incorporated in the bore log. If possible, the position of the water table just after monsoon period be ascertained from local people and indicated in the report.

### **7.3 LABORATORY TESTS**

The method and procedure of testing of soil sample to be followed shall be as per relevant IS codes. Adequate volume of test samples shall be collected from site. Sample shall be properly sealed immediately after recovery as specified in relevant IS code and transported carefully to laboratory for carrying out necessary laboratory tests. Date and time of taking of the sample shall be recorded in the test report.

### **7.4 REPORT ON SUB-SOIL INVESTIGATION**

The contractor shall make analysis of soil samples collected by him in the field and approved by the Owner. A comprehensive report shall have to be prepared by him, finally incorporating all the data collected in proper tabular forms or otherwise along with the analysis.

Three copies of report in the draft form shall be submitted for Owner's approval. 6(six) copies of final report incorporating Owner's comments, if any, shall be submitted within } one week after completion of this work.

Recommendations shall include but not be limited to the following items (a) to

(o)

1. Geological information of the region.

2. Past observations and historical data, if available, for the area or for other areas with similar profile or for similar structures in the nearby area.
3. Procedure of investigations employed at field as well as laboratory test results.
4. Net safe bearing capacity and settlement computation for different types of foundations for various widths and depths of tower and building.
5. Recommendations regarding stability of slopes, during excavations etc.
6. Selection of foundation types for towers, transformers and buildings etc.
7. Bore hole and trial pit logs on standard proforma showing the depths, extent of various soil strata etc.
8. A set of longitudinal and transverse profiles connecting various boreholes shall be presented in order to give a clear picture of the site, how the soil/rock strata are varying vertically and horizontally.
9. Depth of ground water table and its effect on foundation design parameters.
10. Recommendations regarding stability of slopes, during shallow excavation etc.
11. Whether piles are necessary or not. If piles are necessary, recommendation of depth, diameter and types of piles to be used.

## **8.0 CONDUCTOR**

AAA conductors of 100 Sq mm (7/4.26) AAAC will be used in 11 KV lines and that of **148 sq mm mm (19/3/15) AAAC will be used in 33 KV lines.**

### **8.1 CLEARANCE FROM GROUND, BUILDING, TREES ETC.**

**8.2 Clearance** from ground, buildings, trees and telephone lines shall be provided in conformity with the Indian Electricity Rules, 1956 as amended up to date. The bidder shall select the height of the poles such that all electrical clearances are maintained.

**8.3 Guarding mesh** shall be used in all electric line / telecom line / road / drain / canal crossing and at all points as per statutory requirements. The bidder shall provide & install anti climbing devices and danger plates on all poles. Where there is no such provision in the existing line.

**3.0.5.3 Pole accessories** like danger plates, and number plates shall be provided as per REC Standard.

### **3.0.6. TOWERS/ POLES**

Support Structures may be of lattice type or joist or PSC poles. The total steel structures to be inducted to the existing or as additional features should be Galvanized with minimum zinc coating of 610 gms / Sq. Mts. Any new design (approved and tested in any approved test bed) as per the required parameters is also acceptable. In case of 11KV lines the conventional PSC poles shall be used in rural areas and Joist poles in urban areas. No more MS poles without Galvanization will be used. For easy transportation two pieces of galvanized poles with single splice joint using galvanized sections of channels/angles/plates of adequate size along with required size GI bolt nuts & spring washers is to be adopted. Full length welding is to be done on either side in the base level. The materials must conform to IS: 800. All the test on materials and fabrication etc will be as per the relevant Indian standards

In different crossings the contractor shall take into consideration the prevailing regulations of the respective authorities before finalizing type and location of the towers. While carrying out survey work, the contractor has to collect all relevant data, prepare and submit drawings in requisite number for obtaining clearance from road, aviation, railways, river and forest authorities.

#### **4.0 ERECTION WORK**

When the survey is approved, the contractor shall submit to the Owner a complete detail schedule of all materials to be used in the line. Size and length of conductor etc. are also to be given in the list. This schedule is very essential for finalizing the quantities of all line materials. The contractor shall furnish the same.

#### **4.1 SCHEDULE OF ERECTION PROGRAMME**

After due approval of the detailed and check survey, the contractor shall submit to the Owner a complete detailed schedule of erection programme with a Bar-Chart for construction of the lines indicating therein the target date of completion.

#### **4.2 DRAWINGS FOR TOWER AND FOUNDATIONS**

Indicative drawings of poles, structures etc with foundation have been provided by OWNER in the bid document. Other drawings shall be submitted by the contractor for approval by the OWNER.

#### **5.0 CONSTRUCTION OF FOUNDATION FOR TOWER, G.I (RS Joist) POLES AND PSC POLES**

##### **5.0.1 ERECTION OF POLE, CONCRETING OF POLES AND COMPACTION OF SOIL**

Drawing for the excavation of pits, Foundation of soil is enclosed which are to be adopted. If better design with less volume approved or tested by any other distribution agencies will also be acceptable.

**5.0.2** Following arrangement shall be adopted for proper erection of poles wherever necessary and properly compacting of the soil around the base / foot of the poles, under this package.

- (a) Excavation has to done as per the drawing to the required depth and size. After final excavation the pit should be dressed properly so that uneven portion

and loose soil should be removed before PCC (**M-7.5**) of thickness 75 mm is laid. The base footing of the pole concreting RCC (M-15) has to be done by proper alignment and verticality.

(b) The verticality and leveling of pole/structure should be done by the help of plumbob or with theodolite and leveling instrument.

**(c) In case of Joist pole Base clits and in case of PSC pole GI base plate(450x450x10)mm shall to be provided over the Lean concrete.**

### **5.0.3 CEMENT CONCRETE (PLAIN OR REINFORCED), STUB SETTING GROUNDING AND BACK FILLING etc.**

#### **A) Materials**

All materials whether to be consumed in the work or used temporarily shall conform to relevant IS specification, unless stated otherwise, and shall be of the best approved quality.

#### **B) Cement**

Cement to be used in the work under the contract shall generally conform to IS:269/455-1989. Cement bags shall be stored by the contractor in a water tight well ventilated store sheds on raised wooden platform (raised at least 150 mm above ground level) in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter. Cements to be used within three months from the date of manufacture. Sub-standard or partly set cement shall not be used and shall be removed from the site by the contractor at his cost .

**C) Coarse Aggregates** i.e Stone chips or stone ballast. For M15 concrete (mix 1:2:4) the aggregate will be in the ranges from 12mm to 20mm.size and for M7.5 concrete (mix 1:4:8) these will be from 25mm to 40mm size.

#### **D) Pole erection**

1. **After proper alignment**, checking of verticality and leveling, the pole or structure should be properly tied before placing of base concrete of required height. Again the verticality and leveling should be checked.
2. **The RCC pedestal concrete** (M-15) is to be done by providing good quality of shutters, so that there will no leakage of cement slurry during concreting. The cooping height should be **450 mm/750 mm** above the existing ground level in urban area and in cultivated lands respectively. The top portion of the cooping should be made tapered.
3. **Above** the cooping 450 mm of pole or structure should be painted with double layer of Black Bituminous paints.
4. **All the bolted joints** should be tightened properly by providing suitable size GI Bolt Nuts and Spring washers. After completion of erection works all the bolts should be spot welded in order to avoid theft of members.
5. **The back filling** of locations should be done by using the excavated soil only in layers (each layer should not be more than 500 mm) by putting water and ramming by using wooden rammers. In no case stone of size more than 75mm used for back filling. Back-filling has to be done 75mm above ground level or as specified
6. **Curing of concrete** should be done for 28 day continuously. Curing should not be done within 24 Hours of concreting.
7. **All the excess** excavated materials and other unused materials from the concreting site should be disposed of to a suitable site by the contractor.
  - a) Mixer (Running time-2 min.)
  - b) **In case of** hand mixing, 10% extra cement has to be provided.  
Hand mixing should be done on GI sheet platform only.
  - c) **Poking rod** may be used for compacting in locations at PSC poles only
  - d) **Use of vibrator** for compacting is mandatory.
  - e) **Clean water** (free from saline and alkaline) should be used for concreting.

- f) **Aggregates** (both coarse and fine) used should be free from foreign materials.
- g) **Shutters** used should not be removed before 24hrs. of casting.
- h) **In case of** black cotton soil borrowed earth (morum soil mixed with sand is preferable) may be used for back filling.
- i) **Sufficient qty. of water** should be sprinkled over backfilled earth and chimney kept wet by using wet gunny bags.

**5.0.4 All the persons** working on tower shall wear safety helmet, safety belt and safety shoes, Similarly all the persons working on ground shall wear safety helmet and safety shoes.

**5.0.4.1. If there is any LT/HT** power line near the vicinity of tower erection, necessary shutdown of the power line shall be obtained in writing from the concerned Agency in order to avoid electrical hazards caused by accidental touching of stay/Guy ropes with power line.

**5.0.4.2 Safety precaution** Safety shall be given utmost importance during stringing. The following need to be ensured.

**5.0.4.3 Safe working** conditions shall be provided at the stringing site.

**5.0.4.4 Full proof communication** through walky- talkie / mobile phones shall be used in order to avoid any damage to workmen or public on ground.

**5.0.5 In case of 11 KV, 10m 300 kg PSC pole in rural area and 11 kV Joist pole in urban area shall be adopted. In case of 33 kV 11 kV Joist pole to be used**

## **TECHNICAL SPECIFICATIONS**

### **I. Qualification Criteria of Sub Vendor / Manufacturer:-**

The prospective bidder contractor may source PSC Poles from manufacturers who should have supplied at least the following quantity of PSC Poles to Electricity Supply Utilities / PSUs. The bidder should enclose Performance Certificates from the above users, issued in favour of the Sub Vendor / manufacturer, as proof of successful operation in field.

Sl. No.	Size	Minimum Past Supply Qty
1	10 Mtr. X 300 Kg	200

**Applicable Standard :**

The Poles shall comply with latest standards as under:  
 REC Specification No. 15/1979, REC Specification No. 24/1983, IS 1678, IS 2905, IS 7321.

**Pres-Stressing Steel**

Pre-stressing steel wires including those used as un tensioned wires should conform to IS:1785 (Part-I) (Specification for plain hard-drawn steel wire for pre-stressed concrete, Part-I cold drawn stress relieved wire).IS:1785 (Part-II)(Specification for plain hard-drawn steel wire) or IS:6003 (Specification for indented wire for pre-stressed concrete).The type design given in the annexure are for plain wires of 4 mm diameter with a guaranteed ultimate strength of 160 kg/mm<sup>2</sup>. All pre-stressing steel shall be free from splits, harmful scratches, surface flaw, rough, aged and imperfect edges and other defects likely to impair its use in pre-stressed concrete.

**Concrete Mix**

Concrete mix shall be designed to the requirements laid down for controlled concrete (also called design mix concrete) in IS: 1343-1980 (Code of practice for pre-stressed concrete) and IS: 456 – 1978 (Code of practice for plain and reinforced concrete) subject to the following special conditions:  
 Minimum works cube strength at 28 days should be at least 420 Kg/cm<sup>2</sup>.  
 The concrete strength at transfer should be at least 210 Kg/cm<sup>2</sup>.  
 The mix should contain at least 380 Kg of cement per cubic meter of concrete.  
 The mix should contain as low water content as is consistent with adequate workability. It becomes necessary to add water to increase the workability the cement content also should be raised in such a way that the original value of water cement ratio is maintained.

**III. Design Requirements**

The poles shall be designed for the following requirements:

The poles shall be planted directly in the ground with a planting depth as per IS: 1678. Wherever, planting depth is required to be increased beyond the specified limits or alternative arrangements are required to be made on



account of ground conditions e.g. water logging etc., the same shall be in the scope of the bidder at no extra cost to owner. The bidder shall furnish necessary design calculations/details of alternative arrangements in this regard.

The working load on the poles should correspond to those that are likely to come on the pole during their service life.

The factor of safety for all poles shall not be less than 2.5.

The average permanent load shall be 40% of the working load.

The F.O.S. against first load shall be 1.0.

At average permanent load, permissible tensile stress in concrete shall be 30 kg/cm<sup>2</sup>.

At the design value of first crack load, the modulus of rupture shall not exceed 53.0kg/cm<sup>2</sup> for M-40.

The ultimate moment capacity in the longitudinal direction should be at least one fourth of that in the transverse direction.

The maximum compressive stress in concrete at the time of transfer of pre-stress should not exceed 0.8 times the cube strength.

The concrete strength at transfer shall not be less than half, the 28 days strength ensured in the design. For model check calculations on the design of poles, referred to in the annexure, a reference may be made to the REC "Manual on Manufacturing of solid PCC poles, Part-I-Design Aspects".

#### **IV. Dimensions and Reinforcements**

The cross-sectional dimensions and the details of pre-stressing wires should conform to the particulars given in the enclosed drawing. The provisions of holes for fixing cross-arms and other fixtures should conform to the REC specification No.15/1979.

All pre-stressing wires and reinforcements shall be accurately fixed as shown in drawings and maintained in position during manufacture. The un-tensioned reinforcement as indicated in the drawings should be held in position by the use of stirrups which should go round all the wires.

All wires shall be accurately stretched with uniform pre-stress in each wire. Each wire or group of wires shall be anchored positively during casing. Care should be taken to see that the anchorages do not yield before the concrete attains the necessary strength.

#### **V. Cover**

The cover of concrete measured from the outside of pre-stressing tendon shall be normally 20 mm.

#### **VI. Welding and Lapping of Steel**

The high tensile steel wire shall be continuous over the entire length of the tendon. Welding shall not be allowed in any case. However, joining or coupling may be permitted provided the strength of the joint or coupling is not less than the strength of each individual wire.

#### **VII. Compacting**

Concrete shall be compacted by spinning, vibrating, shocking or other suitable mechanical means. Hand compacting shall not be permitted.

#### **VIII. Curing**

The concrete shall be covered with a layer of sacking, canvass, Hessian or similar absorbent material and kept constantly wet up to the time when the strength of concrete is at least equal to the minimum strength of concrete at transfer of pre-stress. Thereafter, the pole may be removed from the mould and watered at intervals to prevent surface cracking of the unit the interval should depend on the atmospheric humidity and temperature. The pre-stressing wires shall be de-tensioned only after the concrete has attained the specified strength at transfer (i.e. 200 or 210 kg/cm<sup>2</sup> as applicable). The cubes cast for the purpose of determining the strength at transfer should be cured, as far as possible, under condition similar to those under which the poles are cured. The transfer stage shall be determined based on the daily tests carried out on concrete cubes till the specified strength indicated above is reached. Thereafter the test on concrete shall be carried out as detailed in IS: 1343 (code of practice for pre-stressed concrete). The manufacture shall supply, when required by the owner or his representative, result of compressive test conducted in accordance with IS: 456 (Code of practice for plain and reinforced concrete) on concrete cubes made from the concrete used for the poles. If the manufacture so desired, the manufacture shall supply cubes for test purpose and such cubes shall be tested in accordance with IS: 456 (Code of practice for plain and reinforced concrete).

#### **IX. Lifting Eye-Hooks or Holes**

Separate eye-hooks or hoes shall be provided for handling the transport, one each at a distance of 0.15 times the overall length, from either end of the pole. Eye-hooks, if provided, should be properly anchored and should be on the face that has the shorter dimension of the cross-section. Holes, if provided for lifting purpose, should be perpendicular to the broad face of the pole.

**X. Holes for Cross Arms etc**

Sufficient number of holes shall be provided in the poles for attachment of cross arms and other equipments.

**XI. Stacking & Transportation**

Stacking should be done in such a manner that the broad side of the pole is vertical. Each tier in the stack should be supported on timber sleeper located as 0.15 times the overall length, measured from the end. The timber supported in the stack should be aligned in vertical line.

**XII. Earthing**

(a) Earthing shall be provided by having length of 6 SWG GI wire embedded in Concrete during manufacture and the ends of the wires left projecting from the pole to a length of 100mm at 250 mm from top and 1000 mm below ground level.

(b) Earth wire shall not be allowed to come in contract with the pre-stressing wires.

**B. PSC Pole (10mtr)**

**GUARANTEED TECHNICAL PARTICULARS**

(To be submitted along with offer)

			10mtr X 300 Kg	10 Mtr X 400 Kg
1	Type of pole			
2	Factor of Safety			
3	Overall Length of Pole Meters	meters		
4	Working Load Kg	Kg		
5	Overall Dimensions			
A	Bottom Depth	mm		
B	Top Depth			
C	Breadth			
6	Reinforcement Detail:			
7	Diameter of prestressing wire			
8	No. of Tensioned wires			
9	No. of Untensioned wire			
10	Length of each untensioned wire			
11	Concrete Detail			
A	Cement Type			
B	Grade			
C	Type			
D	Quantity	Cubic meter/pole		
E	Standard confirming to:			
12	Steel Quality	Kg/Pole		
A	Ultimate Tensile Strength (UTS)	Km/Cm <sup>2</sup>		
B	Weight			

**5.0.5.1 All the poles shall be provided with a RCC block base or MS base plate having dimensions as mentioned at 5.0.2 © as per the site requirement to be decided by Engineer in Charge. The decision of Engineer in Charge will be Final.**

**5.0.5.2** The poles shall then be lifted to the pit with the help of wooden supports. The pole shall then be kept in the vertical position with the help of 25 mm (min.) manila ropes, which will act as the temporary anchor. The verticality of the pole shall be checked by spirit level in both longitudinal & transverse directions. The temporary anchor shall be removed only when **poles set properly in the pit for foundation concreting & backfilling with proper compacting the soil. The backfilling should be done in layers (maxm. 0.5 mts at a time with sprinkling of water and by using wooden hammer. No stone more than 75 mm should be used during back filling.**

**5.0.5.3** Suspension type H/W fittings in all tangent locations and Four pair bolted type tension H/W fittings should be used in all new 33 & 11 Kv lines. 45 KN & 70 KN normal B&S insulators will be used in suspension & tension locations respectively.

**5.0.5.4** Concreting of foundation up to a minimum height of 1.8 mtrs from the bottom of the pit with a circular cross-section of radius 0.25 mtrs. (volume of 0.3 cu.mtr. per pole) in the ratio of 1:2:4 shall be done at the following locations: The **depth** has to be increased to 2mtr or as required at site condition if poles more than 11 Mts. are to be used.

- i) At all the tapping points and dead end poles.
- ii) At all the points as per REC construction dwg. No. A-10 (for the diversion angle of 10-60 degree) or better there of as per the instruction of Engineer in charge. The decision of Engineer in charge will be final.**
- iii) Both side poles at all the crossing for road, Nallaha railway crossings etc.
- iv) Where Rail poles, Joist poles, double pole and four pole structures are to be erected.

## **6.0. Earthing of Support**

**6.0.1** Each pole shall be earthed with coil type earthing as per REC Construction Standard J-1.

**6.0.2** All DP & Four pole structures & the poles on both sides of railway crossing shall be earthed by providing two nos. **pipe earthing as per Drawing provided by OWNER.**

**6.0.3** Each tower/structures should be earthed by providing 2.5 mts.50x6 GI flat and 40 x 3000 mm heavy gauge ISI mark earthing pipe. The top of the earthing pipe should remain 600 mm below ground level. All railway X-ing locations two nos. earthing should be provided.

In case the required footing resistance is not achieved on measurement, counterpoise earthing has to be provided as per the standard.

#### **7.0.4 (A)**

#### **HT & LT STAY SETS**

#### **TECHNICAL SPECIFICATION**

##### **I. Qualification Criteria of Manufacturer:-**

The prospective bidder may source Stay Sets from manufacturers only must qualify all the following requirements :

a) Manufacturer must have successfully carried out Type Test of similar item from any NABL Accredited Laboratory within the last 5 years, prior to the date of submission of the bid.

b) The manufacturer should have supplied at least 1000 sets (both HT & LT taken together) to electricity supply utilities / PSUs. The bidder should enclose

Performance Certificates from the above users issued in the name of the manufacturer as proof of successful operation in field.

## **II. SCOPE**

This specification covers design, manufacture, testing and dispatch of LT Stay Sets of 16 mm and HT stay sets 20 mm dia.

## **III. GENERAL REQUIREMENTS**

### **16 MM Dia Stay sets (Galvanized) – LT Stay Set**

This stay sets (Line Guy set) will consist of the following components:-

#### **Anchor Rod with one washer and Nut**

Overall length of rod should be 1800 mm to be made out of 16 mm dia GI Rod, one end threaded up to 40 mm length with a pitch of 5 threads per cm and provided with one square GI washer of size 40X40x1.6mm and one GI hexagonal nut conforming to IS:1367:1967 & IS:1363:1967. Both washer and nut to suit threaded rod of 16 mm dia. The other end of the rod to be made into a round eye having an inner dia of 40mm with best quality welding.

#### **Anchor Plate Size 200 x 200 x6 mm**

To be made out of GI plate of 6 mm thickness. The anchor plate should have at its centre 18 mm dia hole.

#### **Turn Buckle & Eye Bolt with 2 Nuts**

To be made of 16 mm dia GI Rod having an overall length of 450mm, one end of the rod to be threaded up to 300 mm length with a pitch of 5 threads per cm and provided with two GI Hexagonal nuts of suitable size conforming to IS:1363:1967 & IS:1367:1967. The other end of rod shall be rounded into a circular eye of 40mm inner dia with proper and good quality welding.

#### **Bow with Welded Angle**



To be made out of 16mm dia GI rod. The finished bow shall have an overall length of 995 mm and height of 450 mm, the apex or top of the bow shall be bent at an angle of 10°. The other end shall be welded with proper and good quality welding to a Gangle 180 mm long having a dimension of 50x50x6mm. The angle shall have 3 holes of 18 mm dia each.

### **Thimble**

To be made on 1.5 mm thick GI sheet into a size of 75x22x40mm and shape as per standard shall be supplied.

Average Weight of Finished 16mm Stay Sets shall be at least 7.702 KG (Minimum)

(Excluding Nuts Thimbles and Washer) 8.445 Kg. (Maximum)

### **20 mm Dia Stays Sets for 33 Kv, 11 KV Lines (Galvanized) HT Stay Set**

The Stay Set (Line Guy Set) will consist of the following components:

#### **Anchor Rod with one Washer and Nut**

Overall length of Rod should be 1800mm to be made out of 20 mm dia GI rod one end threaded up to 40 mm length with a pitch of threads per cm. And provided with one square G.I Washer of Size 50x50x1.6mm and one GI Hexagonal nut conforming to IS: 1363:1967 & IS:1367:1967. Both washer and nut to suit the threaded rod of 20mm. The other end of the rod to be made into a round eye having an inner dia of 40mm with best quality of welding. Dimensional and other details are indicated and submitted by bidders for owner's approval before start of manufacturing.

#### **Anchor Plate Size 300 x 300 x 8 mm**

To be made out of G.S. Plate of 8 mm thickness. The anchor plate to have at its centre 22mm dia hole.

#### **Turn Buckle, Eye Bolt with 2 Nuts.**

To be made of 20 mm dia G.I Rod having an overall length of 450 mm. One end of the rod to be threaded up to 300 mm length with a pitch of 4 threads per cm. The 20 mm dia bolt so made shall be provided with two G.I Hexagonal nuts of suitable size conforming to IS: 1363:1967 & IS: 1367:1967. The other end of the rod shall be rounded into a circular eye of 40mm inner dia with

proper and good quality of welding. Welding details are to be indicated by the bidder separately for approval.

#### **Bow with Welded Channel:**

To be made out of 16mm dia G.I.Rod. The finished bow shall have an overall length of 995 mm and height of 450 mm. The apex or top of the bow shall be bent at an angle of 10R. The other end shall be welded with proper and good quality welding to a G.I Channel 200 mm long having a dimension of 100x50x4.7 mm. The Channel shall have 2 holes of 18 mm dia and 22 dia hole at its centre as per drawing No.3 enclosed herewith.

#### **Thimble 2 Nos.**

To be made of 1.5 mm thick G.I.sheet into a size of 75x22x40mm and shape as per standard.

#### **Galvanizing**

The complete assembly shall be hot dip galvanized.

#### **Welding**

The minimum strength of welding provided on various components of 16mm and 20 mm dia stay sets shall be 3100 kg & 4900 kg respectively. Minimum 6mm fillet weld or its equivalent weld area should be deposited in all positions of the job i.e. at any point of the weld length. The welding shall be conforming to relevant IS:823/1964 or its latest amendment.

#### **Threading**

The threads on the Anchor Rods, Eye Bolts and Nuts shall be as per specification IS; 4218:1967 (ISO Metric Screw Threads). The Nuts shall be conforming to the requirements of IS: 1367:1967 and have dimension as per IS 1363:1967. The mechanical property requirement of fasteners shall conform to the properly clause 4.6 each for anchor rods and Eye bolt and property clause 4 for nuts as per IS: 1367:1967.

Average weight of finished 20 mm Stays Set: 14.523 Kg.(Min) (Excluding Nuts Thimble & Washer) :15.569 Kg.(Max.)

## **IV. TESTS**

The contractor shall be required to conduct testing of materials at Govt./Recognized testing laboratory during pre-dispatch inspection for Tensile Load of 3100 Kg/4900Kg. applied for one minute on the welding and maintained for one minute for 16 mm and 20mm dia stay sets respectively.

## V. IDENTIFICATION MARK

All stay sets should carry the identification mark of the Purchaser (OWNER)applicable.

This should be engraved on the body of stay rods to ensure proper identification of the materials. The nuts should be of a size compatible with threaded portion of rods and there should be not play or slippage of nuts.

Welding wherever required should be perfect and should not give way after erection.

## VI. TOLERANCES

The tolerances for various components of the stay sets are indicated below subject to the condition that the average weight of finished stay sets of 16mm dia excluding nuts, thimbles and washers shall not be less than the weight specified above:-

**B) HT /LT STAY SET  
GURANTEED TECHNICAL PARTICULARS  
(To be submitted along with Offer)**

SI No.	Item Description	Specified Parameters			Bidder's Offer
		Section Tolerances	Fabrication Tolerances	Material	
1	Anchor Plate	6mm thick +2.5%- 5%	200x200mm+ 1%	GIPlate 6 mm thick	LT Stay Set HT Stay Set
		8mm thick+2.5% - 5%	300x300mm+ 1%	GIPlate 8 mm thick	
2	Anchor Rod	16mmdia +5%-	Length 1800mm+0.5	GI Round 16mm dia	LT Stay Set HT Stay Set

		3% 20mm dia +3%- 2%	% Rounded Eye 40 mm inside dia + 3% Threading 40mm +11%-5% Length 1800mm +0.5% Round Eye 40mm inside dia + 3%. Threading 40mm +11%-5%	GI Round 16mm dia GI Round 20mm dia GI Round 20mm dia		
<b>3</b>	Turn Buckle Bow	16mm dia +5%- 3%	Length 995mm +1% 16mm dia Length 180m m +1% 50x50x6mm Channel length 200mm + 1%	GI Round 16mm dia. GI Angle GI Channel 100x50x4.7m m	<b>LT Stay Set</b> <b>HT Stay Set</b>	
<b>4</b>	Eye Rod Bolt	16mm dia +5%- 3% 20mm dia + 3% - 2%	Length 450mm + 1% Threading 300mm +1% Round Eye 40mm inside dia +3% Length 450m m +1% Threading 300mm +1% Round Eye 40 mm inside dia	GI Round 16 mm dia GI Round 20mm dia.	<b>LT Stay Set</b> <b>HT Stay Set</b>	

			+3%			
<b>5</b>	Galvanisati on thickness				<b>LT Stay Set HT Stay Set</b>	
<b>A</b>	Anchor Plate				<b>LT Stay Set HT Stay Set</b>	
<b>B</b>	Anchor Rod				<b>LT Stay Set HT Stay Set</b>	
<b>C</b>	Turn Buckle				<b>LT Stay Set HT Stay Set</b>	
<b>D</b>	Eye Bolt Rod				<b>LT Stay Set HT Stay Set</b>	
<b>6</b>	Weight of complete set				<b>LT Stay Set HT Stay Set</b>	
<b>7</b>	Whether drawing submitted					

**(C) STAY WIRE (7/8SWG) / (7/10 SWG) & (7/12 SWG)**

**TECHNICAL SPECIFICATIONS**

**I. Qualification Criteria of Manufacturer:-**

The prospective bidder may source Stay Wire from manufacturers only who must qualify all the following requirements :

a) The manufacturer must have successfully carried out Type Test of similar item from any NABL Accredited Laboratory within the last 5 years, prior to the date of submission of the bid.

b) The manufacturer should have supplied at least 1000 Kg (all sizes taken together) to electricity supply utilities / PSUs. The bidder should enclose Performance Certificates from the above users issued in the name of the manufacturer as proof of successful operation in field.

**II. Application Standards**

Except when they conflict with the specific requirements of this specification, the G.I Stay Stranded Wires shall comply with the specific requirements of IS: 2141-1979, IS: 4826-1979 & IS: 6594-1974 or the latest versions thereof.

### III. Application and Sizes

The G.I. stranded wires covered in this Specification are intended for use on the overhead power line poles, distribution transformer structures etc.

The G.I stranded wires shall be of 7/8SWG 7/4 mm for 33 kv lines, 7/10SWG (7/3.15 mm for 11KV lines and 7/12 SWG 7/2.5 mm for LT lines standard sizes.

### IV. Materials

The wires shall be drawn from steel made by the open hearth basic oxygen or electric furnace process and of such quality that when drawn to the size of wire specified and coated with zinc, the finished strand and the individual wires shall be of uniform quality and have the properties and characteristics as specified in this specification. The wires shall not contain sulphur and phosphorus exceeding 0.060% each.

#### Tensile Grade

The wires shall be of tensile grade 4, having minimum tensile strength of 700 N/mm<sup>2</sup> conforming to IS:2141.

#### General Requirements

The outer wire of strands shall have a right-hand lay.  
The lay length of wire strands shall be 12 to 18 times the strand diameter.

#### Minimum Breaking Load

The minimum breaking load of the wires before and after stranding shall be as follows:

No. of Wires	Wire Dia (mm)	Min. breaking load of the Single	Min. breaking load of the
--------------	---------------	----------------------------------	---------------------------

<b>&amp; Const.</b>		<b>wire before stranding (KN)</b>	<b>standard wire (KN)</b>
7 (6/1)	2.5	3.44	21.40
7 (6/1)	3.15	5.46	34.00
7 (6/1)	4.0	8.80	54.9

## **V. Construction**

The galvanized stay wire shall be of 7-wire construction. The wires shall be so stranded together that when an evenly distributed pull is applied at the ends of completed strand, each wire shall take an equal share of the pull. Joints are permitted in the individual wires during stranding but such joints shall not be less than 15 metres apart in the finished strands.

The wire shall be circular and free from scale, irregularities, imperfection, flaws, splits and other defects.

## **VI. Tolerances**

A tolerance of (+) 2.5% on the diameter of wires before stranding shall be permitted.

## **VII. Sampling Criteria**

The sampling criteria shall be in accordance with IS :2141.

## **VIII. Tests on Wires before Manufacture**

The wires shall be subjected to the following tests in accordance with IS :2141.  
Ductility Test Tolerance on Wire Diameter

### **Tests on Completed Strand**

The completed strand shall be tested for the following tests in accordance with IS:2141. Tensile and Elongation Test: The percentage elongation of the stranded wire shall not be less than 6%.

Chemical analysis Galvanizing Test

The Zinc Coating shall conform to "Heavy Coating" as laid down in IS:4826

## IX. Marking

Each coil shall carry a metallic tag, securely attached to the inner part of the coil bearing the following information:

- a) Manufacturers name or trade mark
- b) Lot number and coil number
- c) Size
- d) Construction
- e) Tensile Designation
- f) Lay
- g) Coating
- h) Length
- i) Mass
- j) ISI certification mark, if any

## X. Packing

The wires shall be supplied in 75-100 Kg. coils. The packing should be done in accordance with the provisions of IS:6594

## XI. Other Items:

For remaining items of stay sets mentioned in the enclosed drawing, relevant applicable Indian standards shall be applicable.

### (D) STAY WIRE (7/10 SWG) (7/10 SWG) & (7/12 SWG)

#### GURANTEED TECHNICAL PARTICULARS

(To be submitted along with offer)

Sl. No.	GENERAL TECHNICAL PARTICULARS	7/08 SWG	7/10 SWG	7/12 SWG
1	Nominal diameter of wire			
2	Tolerance in diameter			
3	Sectional Area (In Sq. mm.)			
4	Tensile strength			
A	Min. N/mm <sup>2</sup>			
B	Max. N/mm <sup>2</sup>			



<b>5</b>	Minimum breaking load (KN)			
<b>6</b>	Type of coating Heavy/Medium/Light			
<b>7</b>	Variety Hard/Soft			
<b>8</b>	Weight of Zinc coating (Gms/Sq. Mtr.) Min.			
<b>9</b>	No. of dips the coating is able to withstand as 18 ± 20°C			
<b>10</b>	Adhesion Test (Wrap Test at 1 turn per second coiling while stress not exceeding % nominal tensile strength)			
<b>A</b>	Min. complete turn of wrap			
<b>B</b>	Dia of mandrel on which wrapped			
<b>11</b>	Bend Test			
<b>A</b>	Angle			
<b>B</b>	Dia round a format to be bent			
<b>12</b>	Freedom from defect			
<b>13</b>	Chemical composition the MS Wire used shall not exceed			
<b>A</b>	Sulphur 0.060%			
<b>B</b>	Phosphorous 0.065%			

**(E) GI WIRE 6 SWG & GI WIRE 8 SWG**

**TECHNICAL SPECIFICATIONS**

**I. Qualification Criteria of Manufacturer:-**

The prospective bidder may source GI Wire from manufacturers only who must qualify all the following requirements :

a) The manufacturer must have successfully carried out Type Test of similar item from any NABL Accredited Laboratory within the last 5 years, prior to the date of submission of the bid.

b) The manufacturer should have supplied at least 1000 Kgs. (all sizes taken together) to electricity supply utilities / PSUs. The bidder should enclose Performance Certificates from the above users issued in the name of the manufacturer as proof of successful operation in field.

**II. SCOPE**

This specification covers manufacture, testing and supply of hot dip galvanized MS solid wire of sizes 6 SWG (5 MM) & 8 SWG (4 MM) diameter.

### **III. APPLICABLE STANDARDS**

#### **ZINC**

Zinc shall conform to grade Zen 98 specified in IS 209& IS:4826-1979 with upto date amendments.

#### **ZINC COATING**

Zinc coating shall be in accordance with IS:4826-1979 for heavily coated hard quality.

#### **GALVANISING**

Galvanizing shall be as per IS:2629-1966, IS 4826-1979 with up to date amendments

#### **UNIFORMITY OF ZINC COATING**

Uniformity of zinc coating shall be as per IS:2633-1972 with up to date amendments

#### **TENSILE PROPERTIES**

The tensile strength of the wire after galvanizing shall be between 55-95 Kg/sq.mm ensuring MS wire mechanical properties as per IS-28:1972 8.1 to 8.3.

#### **FREEDOM FROM DEFECTS**

As per IS:2629-1966 & 4826-1979 & with up to date amendments be ensured

### **IV. MATERIAL**

The mild steel wire shall have chemical composition maximum sulphur-0.055%, phosphorous -0.055%,Carbon 0.25%.

### **V. TESTS**

During the process of manufacturer/fabrication and all tests for chemical, mechanical, galvanizing as per IS- 280-1979, IS1521-1972, IS-1755-1961,

IS:6745-1972 & 4826-1979 shall be carried out. The certificate towards, chemical composition shall be submitted for each lot offered for inspection. The following tests shall be conducted in presence of the representative of the purchaser:

Visual physical inspection and measurement of specified dimension

Coating test as per IS:1755-1961, IS 2629-1966, IS:2633-1972, IS:4826-1969

Adhesion test as per IS:1755-1961,IS:2629-1966,IS:2633-1972,IS:4826-1969,&IS:6745-1972

Tensile strength and breaking load and elongation determined as per IS:1521-1972 with up to date amendments

## VI. PACKING & MARKING

Packing shall be as per IS:280-1979 and each coil shall be between 50-100 kg.marking shall be as per IS:280-1972.

### (F) GI WIRE 6 SWG & GI WIRE 8 SWG

#### GUARANTEED TECHNICAL PARTICULARS

(To be submitted along with offer)

Sl. No.	GENERAL TECHNICAL PARTICULARS	6 SWG	8 SWG
1	Nominal diameter of wire		
2	Tolerance in diameter		
3	Sectional Area (In Sq. mm.)		
4	Tensile strength		
A	Min. N/mm <sup>2</sup>		
B	Max. N/mm <sup>2</sup>		
5	Minimum breaking load (KN)		
6	Type of coating Heavy/Medium/Light		
7	Variety Hard/Soft		
8	Weight of Zinc coating (Gms/Sq. Mtr.) Min.		
9	No. of dips the coating is able to withstand as 18 ± 20°C		
10	Adhesion Test (Wrap Test at 1 turn per second coiling while stress not exceeding % nominal tensile strength)		
A	Min. complete turn of wrap		
B	Dia of mandrel on which wrapped		

<b>11</b>	Bend Test		
<b>A</b>	Angle		
<b>B</b>	Dia round a format to be bent		
<b>12</b>	Freedom from defect		
<b>13</b>	Chemical composition the MS Wire used shall not exceed		
<b>A</b>	Sulphur 0.060%		
<b>B</b>	Phosphorous 0.065%		

**(G) EYE BOLT FOR GUARDING**

**TECHNICAL SPECIFICATIONS**

**GENERAL REQUIREMENTS:**

M20 eye bolts (120 mm long) shall preferably be of drop forged manufacture and shall be supplied complete with full thread and two full nuts.

Eye bolt shall be manufactured from steel to ISO 272, 885, 888, 4759/1 and shall meet the requirements for mechanical properties detailed in ISO 272, 885, 888, 4759/1.

Where a welding process is used in manufacture, each eye bolt shall be individually proof tested by the manufacture in accordance with ISO 272, 885, 888, 4759/1 to 125% of its safe working tensile load that is to 48kN. The safe working tensile load shall be the ultimate axial tensile strength divided by the factor of safety of 2.5.

The eye shall be permanently and legibly stamped with the letter METRIC in letters not less than 3mm high. The safe working load of any eye bolt is that load which may be safely carried in an axial direction. If loaded in any other direction the safe working load is reduced and reference shall be made to the following table for safe working load of M20 eye bolts and eye nuts.

**(H) ALUMINIUM BINDING WIRE**

**TECHNICAL SPECIFICATION**

**SCOPE :**

Scope covers manufacture, testing and supply of 3.53 mm dia Aluminium Binding Wire as per IS 398.

**MATERIALS :**

The material comprising the wire shall have the following chemical composition:

Aluminium 99.5% minimum Copper, silicon and iron 0.5% maximum

The surface of the wire shall be smooth and free from all irregularities and imperfections. Its cross sections shall closely approximate that of true circle.

**Characteristics of Aluminium Binding wire**

Diameter of wire			Cross sectional area of nominal dia. Wires (mm)	Weight of wire kg/km	Breaking Load (kN)
Minimum	Nominal	Maximum			
3.15	3.53	3.55	9.787	26.45	1.57

**Inspection and Tests**

The following routine checks and tests shall be carried out on 10% of the coils of aluminium binding wire. If any one sample fails to pass any one of the test nominated for that wire, then samples shall be taken from every coil in the consignment and any coil from which a sample proves defective shall be rejected. On no account shall any rejected material be presented for test again unless with the written approval of, and under conditions determined by the Purchaser.

**Physical properties**

The surface of the finished wires shall be checked to ensure that it is smooth , free from all irregularities, imperfections and inclusions and that its cross section approximates closely that of true circle.

The wire shall be checked to ensure that its diameter and weight are within the values given I the table above characteristic of a aluminium binding wire.

**Ultimate tensile strength**

When tested on a standard tensile testing machine, the value obtained for the ultimate tensile stress shall not be less than 1.57kN

**Wrapping test**

The wire shall withstand one cycle of a wrapping test as follows:

The wire shall be closely wrapped round a wire of its own diameter form a close helix of eight turns. Six turns shall then be unwrapped and again closely rewrapped in the same direction as the first wrapping. The wire shall not break or crack when subjected to this test.

**Packing & Delivery**

The aluminium binding wire shall be delivered in 30m coils, with a permitted tolerance of +5%. Random or non standard lengths shall not be permitted.

Each coil shall be adequately guarded against damage due to transportation and handling and shall have an outer layer of tightly wound polythene tape or be contained in a suitable, transparent plastic bag.

The internal diameter of the wound coil shall not be such as to result in a permanent set in the conductor.

The coils shall be contained in non returnable wooden cases, with a gross weight not in excess of 300 kg. The number of coils contained shall be marked on the outside of each case.

(I)

**ALUMINIUM BINDING WIRE  
GUARANTEED TECHNICAL PARTICULARS**

<b>Item No.</b>	<b>Description</b>	<b>Bidder's Offer</b>
<b>1</b>	Manufacturer Address	
<b>2</b>	Indian Standard No. IS 398 (Part-4) 1994	
<b>3</b>	Material of Binding Wire	
<b>4</b>	Dia. Of Wire	
<b>5</b>	Maximum D.C. resistance at 20 degree centigrade	
<b>6</b>	Indivisual Aluminium Alloy Strands	
<b>a)</b>	Tensile breaking stress	
<b>b)</b>	Elongation on 200 mm length in breaking	
<b>7</b>	Particulars of Raw Materials	
<b>7.1</b>	Aluminium	

	<b>a)</b> Minimum Purity of aluminium	
<b>7.2</b>	Aluminium Alloy	
	<b>a)</b> Aluminium redraw rod conforming to	
	Elements	
	(a) Si	
	(b) Cu	
	( c) Other Element (If any)	
<b>8</b>	Linear mass of Wire	
<b>9</b>	Modulus of Elasticity	
<b>10</b>	Coefficient of Linear Expansion (per deg. Cent.)	

## 8.0 CROSS ARMS

Cross Arms should be made by using 100x50x6 mm GI. channel. For both 33 KV & 11 KV system. Cross Arms made out of M.S. angle shall not be used.

In tower type poles (GI) all the X-arms are part of the structure.

### 33 KV, 11 KV “V” CROSS ARM, BACK CLAMP FOR “V”

#### CROSS ARM & POLE TOP BRACKET (F CLAMP)

#### TECHNICAL SPECIFICATIONS

##### 8.0.1 Qualification Criteria of Manufacturer:-

The prospective bidder may source the above items from manufacturers who must qualify the following requirements:

The manufacturer should have supplied at least 1000 no.s (of each item) to electricity supply utilities / PSUs.

The bidder should enclose Performance Certificates from the above users issued in the name of the manufacturer as proof of successful operation in field.

**a)** Hot Dip Galvanised Cross arms and Pole Top Brackets for both 33 KV & 11kV construction at intermediate and light angle pole shall be fabricated from grade 43A mild steel of channel section and for heavy angle poles, end poles and section poles fabricated from grade 43A mild steel of angle section. The grades of structural steel shall conform to IS – 226: 1975.

**b)** The 33 KV & 11 KV ' V ' Cross arm shall be made out of 100x 50x5.6. mm MS Channel of ( 9.56 kg/mtr weight) .

The Back Clamp for both 33 KV & 11 KV shall be made out of 75 x 10 MS Flat and shall be suitably designed to fit PSC Pole 9 Mtr x 300 Kg , 8 Mtr x 200 Kg.and 9 mtrx415kg

**c)**The Pole Top Bracket (F Clamp) shall be made out of75 x 10 MS Flat suitably designed to fit PSC Pole 9 Mtr x 300 Kg ,10X Mtr x 425 Kg.& 9mtrx415 kg for both 33 KV & 11 KV.

Except where otherwise indicated all dimensions are subject to the following tolerances:

dimensions up to and including 50mm:+1mm: and dimensions greater than 50mm: +2%

All steel members and other parts of fabricated material as delivered shall be free of warps, local deformation, unauthorized splices, or unauthorized bends. Bending of flat strap shall be carried out cold. Straightening shall be carried out by pressure and not by hammering.

Straightness is of particular importance if the alignment of bolt holes along a member is referred to its edges.

Holes and other provisions for field assembly shall be properly marked and cross referenced. Where required, either by notations on the drawing or by the necessity of proper identification and fittings for field assembly, the connection shall be match marked. A tolerance of not more than 1mm shall be permitted in the distance between the center lines of bolt holes.

The holes may be either drilled or punched and, unless otherwise stated, shall be not more than 2mm greater in diameter than the bolts. When assembling the components force may be used to bring the bolt holes together (provided neither members nor holes are thereby distorted) but all force must be removed before the bolt is inserted. Otherwise strain shall be deemed to be present and the structure may be rejected even though it may be, in all other respects, in conformity with the specification.

The back of the inner angle irons of lap joints shall be chamfered and the ends of the members cut where necessary and such other measures taken as will ensure that all members can be bolted together without strain or distortion. In



particular, steps shall be taken to relieve stress in cold worked steel so as to prevent the onset of embitterment during galvanizing. Similar parts shall be interchangeable.

Shapes and plates shall be fabricated and assembled in the shop to the greatest extent practicable. Shearing flame cutting and chipping shall be done carefully, neatly and accurately. Holes shall be cut, drilled or punched at right angles to the surface and shall not be made or enlarged by burning. Holes shall be clean-cut without torn or ragged edges, and burrs resulting from drilling or reaming operations shall be removed with the proper tool.

Shapes and plates shall be fabricated to the tolerance that will permit field erection within tolerance, except as otherwise specified. All fabrication shall be carried out in a neat and workmanlike manner so as to facilitate cleaning, painting, galvanizing and inspection and to avoid areas in which water and other matter can lodge.

Contact surfaces at all connections shall be free of loose scale, dirt, burrs, oil and other foreign materials that might prevent solid seating of the parts.

#### **8.0.2 Fabrication has to be made as per drg. Of ' V ' X-arm, Back clamp & ' F ' clamp.**

##### **GALVANISING**

All type of cross arms back clamps, F clamps & stay clamps shall be hot dip galvanized, are as following:

All galvanizing shall be carried out by the hot dip process, in accordance with Specification IS 2629. However, high tensile steel nuts, bolts and spring washer shall be electro galvanized to Service Condition 4. The zinc coating (610 gms per sq.mt) shall be smooth, continuous and uniform. It shall be free from acid spot and shall not scale, blister or be removable by handling or packing.

There shall be no impurities in the zinc or additives to the galvanic bath which could have a detrimental effect on the durability of the zinc coating.

Before picking, all welding, drilling, cutting, grinding and other finishing operations must be completed and all grease, paints, varnish, oil, welding slag and other foreign matter completely removed.

All protuberances which would affect the life of galvanizing shall also be removed.

**The weight of zinc deposited shall be in accordance with that stated in Standard IS 2629 and shall not less than 0.61kg/m<sup>2</sup> with a minimum thickness of 86 microns for items of thickness more than 5mm, 0.46kg/m<sup>2</sup> (64 microns) for items of thickness between 2mm and 5mm and 0.33kg/m<sup>2</sup> (47 microns) for items less than 2mm thick.**

Parts shall not be galvanized if their shapes are such that the pickling solutions cannot be removed with certainty or if galvanizing would be unsatisfactory or if their mechanical strength would be reduced. Surfaces in contact with oil shall not be galvanized unless they are subsequently coated with an oil resistant varnish or paint.

In the event of damage to the galvanizing the method used for repair shall be subject to the approval of the Engineer in Charge or that of his representative.

**In no case the repair of galvanisation on site will be permitted.**

The threads of all galvanized bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless specifically approved by the Engineer in Charge. All nuts shall be galvanized. The threads of nuts shall be cleaned with a tap and the threads oiled.

Partial immersion of the work shall not be permitted and the galvanizing tank must therefore be sufficiently large to permit galvanizing to be carried out by one immersion.

After galvanizing no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. To avoid the formation of white rust galvanized materials shall be stacked during transport and stored in such a manner as to permit adequate ventilation. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

The galvanized steel shall be subjected to test as per IS-2633.

### **8.0.3**

#### **33 KV & 11 KV V CROSS ARM GURANTEED TECHNICAL PARTICULARS**

(To be submitted along with offer)

Sl. No.	Description Unit		Bidder's offer	
			33 Kv	11 Kv
1	Type of crossarm			
2	Grade of steel			
3	Steel standard			
4	Fabrication Standard			
5	Dimensions	Mm		
6	Steel section utilized			
7	Steel tensile strength	N/cm <sup>2</sup>		
8	Working load	Kg		
9	Details of galvanizing method utilized and standard/specification conforming to?			
10	Weight of cross arm	kg		
11	Whether drawing has been submitted with the bid			

#### 8.0.4

#### POLE TOP BRACKETS (F CLAMP)

#### GURANTEED TECHNICAL PARTICULARS

(To be submitted along with offer)

Sl. No.	Description Unit		Bidder's offer	
			33 Kv	11 Kv
1	Type of crossarm			
2	Grade of steel			
3	Steel standard			
4	Fabrication Standard			
5	Dimensions	Mm		
6	Steel section utilized			
7	Steel tensile strength	N/cm <sup>2</sup>		
8	Working load	Kg		
9	Details of galvanizing method utilized and standard/specification conforming to?			
10	Weight of cross arm	kg		
11	Whether drawing has been submitted with the bid			

#### 8.0.5

#### BACK CLAMP FOR "V" CROSS ARM

#### GURANTEED TECHNICAL PARTICULARS

(To be submitted along with offer)

Sl. No.	Description Unit		Bidder's offer	
			33 Kv	11 Kv
1	Type of Clamp			
2	Grade of steel			
3	Steel standard			
4	Fabrication Standard			
5	Dimensions	Mm		
6	Steel section utilized			
7	Steel tensile strength	N/cm <sup>2</sup>		
8	Working load	Kg		
9	Details of galvanizing method utilized and standard/specification conforming to?			
10	Weight of back clamp	kg		
11	Whether drawing has been submitted with the bid			

#### 8.0.6 Fixing of Cross Arms

After the erection of supports and providing guys, the cross-arms are to be mounted on the support with necessary clamps, bolts and nuts. The practice of fixing the cross arms before the pole erection should be followed.

#### 9.0 INSTALLATION OF LINE MATERIALS

**9.0.1 Insulator and Bindings-** These materials are to be procured from the approved vendors only after type test subsequent to the design approval of CPIO, OWNER

1. Suspension type H/W fittings (Single suspension normally to be used and in important X-ings double suspension fittings to be used) in all tangent locations. In S/S fittings 3 nos. 45 KN normal disc insulators, D/S fittings 6 nos. 45 KN normal disc insulators to **be used in 33 KV line. In case of 11 KV line 2 nos & 4 nos 45 KN B&S normal insulators are to be used.**
2. In angle locations single tension fittings to be used with 4 nos. 70 KN disc insulators. In all road X-ings and other important X-ings Double Tension H/W

fittings 8 nos. 70 KN disc insulators to be used **in case of 33 KV line & in 11 KV line it Should be 45 KN insulators 2 nos. & 4 nos. are to be used.**

3. Suitable pre formed armoured rods should be used in all suspension fittings **in case of higher size Conductors.**
4. Guarding / pilotinsulators at the sharp angle points has to be provided.
5. Fourpair bolted type (**suitable for M-16 bolts**) tension fittings for AAA conductors and compression type tension fittings for ACSR conductors has to be used.
6. The “distribution tie “ meant for pin insulator binding should be of no. 6 size and that of soft annealed wire having a minimum length of 3 mtr.
7. **Compression type jointing sleeves should be used for jointing of conductors only.**

#### **9.0.2 Checking of Suspension Fitting**

- a) It shall be checked that there is no damage to any component of hardware fittings.
- b) It shall be verified that all nuts and bolts are tightened properly.
- c) It shall be made sure that all the necessary security pins (split pins) are fixed properly as per approved drawings.

#### **9.0.3 Insulator hoisting**

- a) Insulators shall be completely cleaned with soft and clean cloth.
- b) It shall be verified that there is no crack or any other damage to insulators.
- c) It is very important to ensure that ‘R’ clips in insulator caps are fixed properly.  
This is a security measure to avoid disconnection of insulator discs.
- d) Both Arcing horns (both at top & bottom) of each insulators string has to be provided.

**Where change of insulators** required, prior to fixing, all insulators shall be cleaned in a manner that will not spoil, injure or scratch surface of the insulator, but in no case shall any oil be used for that purpose.

**OR ( If specified in areas where tower structures can not be used)**

**Pin insulators** shall be used on all poles in straight line and disc insulators on angle and dead end poles. Damaged insulators and fittings, if any, shall not be used. The insulator and its pin should be mechanically strong enough to withstand the resultant force due to combined effect of wind pressure and weight of the conductor in the span.

**The pins for insulators** shall be fixed in the holes provided in the cross-arms and the pole top brackets. The insulators shall be mounted in their places over the pins and tightened. In the case of strain or angle supports, where strain fittings are provided for this purpose, one strap of the strain fittings is placed over the cross-arm before placing the bolt in the hole of cross-arms. The nut of the straps shall be so tightened that the strap can move freely in horizontal direction.

**All materials, which are to be supplied by the contractor should be procured from the approved Manufactures of OWNER 's only. Procurement from any suppliers will not permitted. All the related drawings of materials has to be approved by department. All the materials has to be tested in presence of authorized representative of department as well as officers of third party engaged by Government if any also.**

**10.0 Handling of Conductor**

The Conductor will be supplied by the department from the designated stores of OWNER which the contractor has to lift for the work at their cost. All cares

should be taken not to damage conductor surface during transit. Necessary tools and plants for the same has to be effectively used by the agency.

**10.0.1 Running Out of the Conductors:**

The contractor shall be entirely responsible for any damage to the pole or conductors during stringing. Care shall be taken that the conductors do not touch and rub against the ground or objects, which could scratch or damage the strands.

**10.0.2**The sequence of running out shall be from the top to down i.e. the top conductor shall be run out first, followed in succession by the side conductors. Unbalanced loads on poles shall be avoided as far as possible. When lines being erected run parallel to existing energized power lines, the Contractor shall take adequate safety precautions to protect personnel from the potentially dangerous condition.

**10.0.3 Monitoring of Conductors during Stringing**

- a) The conductor shall be continuously observed for loose or broken strands or any other damage during the running out operations. Repair to conductors, if necessary, shall be carried out with repair sleeves. The final conductor surface shall be clean, smooth and free from projections, sharp points, cuts, abrasions, etc. The Contractor shall be entirely responsible for any damage to the poles during stringing.
- b) Conductor shall be checked constantly as it is unwound from Conductor drum for any broken, damage or loose strand. If any major defect is noticed then the defective portion has to be removed and mid span joint provided. However if the defect is of minor nature i.e. number of damaged strands is not more than 1/6<sup>th</sup> of the total strands in outer layer, a repair sleeve shall be provided.

- c) M.S.(mid span) Joint shall be provided at least 15 meters away from 33 KV line tower. All MS joints should be Compression type by providing suitable aluminium compression pipes. The compression joints should be continuous. In case of AAAC compression joints, minimum 25% over lapping with the previous compression should be done.
- d) There shall not be any Mid-Span joint over Rly / River / Main Road Crossing.
- e) Not more than one M.S. Joint shall be provided in one span for each conductor. Rough sagged conductors of one phase shall be simultaneously tightened by which machine fixed on tower till the desired final sag is achieved.

**N.B:- At some places single ckt. Line triangular fashion may be strung in double ckt. GI poles/ GI structures with lower size conductors. Subsequently higher size conductors (Panther or 232 sq.mm AAAC) will be replaced depending on load growth.**

#### **10.0.4 Stringing of AB Cables**

##### **10.0.4.1 Fixing of Suspension & Tension/ Dead end fittings to the Poles.**

The suspension clamp is to be hung on eye hook/ suspension hook, which is fixed to the pole at a minimum distance of 0.15 mt. from top end of the pole. The messenger wire of bunched cable resting on a pulley is separated from the cable by separating wedges and inserted in the conductor groove of the suspension clamp. The bolt is tightened to a torque of 20 N after which the pulley and wedges are to be removed. The cable is tied to the messenger wire with nylon tie on both sides of clamps. A hole of minimum diameter is to be made through poles for erection of suspension clamp. In case, drilling is not possible to make hole through poles, pole clamps/eye hook 50 x 6 mm flat shall be used. Eye/hook pole clamp shall be made to suite the pole width. This shall be installed as per Fig. No. 2 (a) & 2(b) of REC Construction Standard No. E-34 for suspension clamps and as Fig. No. 2 (a) of REC Construction Standard No. E-35 for tension (Dead end)clamps.



#### **10.0.4.2 Fittings & Accessories**

The following hardware fittings and accessories shall be used to install, erect & join the aerial bunched cable.

- a) Suspension Hook (Eye-Hook) – The Contractor shall install the suspension hook (eye hook). This hook shall be used to attach the AB cable on the pole by means of a dead end clamp in terminal poles and for attaching a suspension clamp in straight lines and angle up to 90 Deg.-
- b) Suspension fittings & the corresponding eye hook shall be as per REC Construction Standard No. e –34.
- c) Dead End fittings shall be bolted type & the corresponding eye hook shall be as per REC Construction Standard No. E-35.
- d) Nylon Tie- The contractor shall supply nylon ties. These ties shall be used for tying the conductors with the messenger wire to prevent the phase conductors from chatting against suspension clamp. The nylon tie is made of weather resistant black nylon.
- e) Connectors- The contractor shall supply connector. These shall be used as non-tension aluminum to aluminum connections for conductor joints.
- f) Plastic Covers for Connectors- The contractor shall install Plastic Covers for Connectors. These covers shall be used with aluminum/aluminum connectors to protect connectors against corrosion caused by climatic conditions.

#### **13.0 STRINGING OF CONDUCTOR**

**13.0.1** The works include spreading of conductors without any damage and stringing with proper tension without any kinks/ damage Jumpering at cut points by using two nos., three bolted, PG claps has to be done. **No binding of two**

**conductors with aluminium wires will be allowed.** In each and every joints three bolted very good quality PG clamps should be used wrapping of suitable aluminium tapes if required as per the decision of the EE/DE. The ground & line clearances at road crossings along roads other crossings shall be as mentioned in this specification.( which also should not be less than the relevant clearances mentioned in I.E. rules.)

**13.0.2** While transporting conductors' drums to site, precautions are to be taken so that the conductor does not get damaged. The drum shall be mounted on cable drum support. The direction of rotation of the drum shall be according to the mark in the drum so that the conductor could be drawn. While drawing the conductor, it shall not rub against surface causing damage. The conductor shall be passed over poles on rubberized or aluminum snatch block (pulley) mounted on the poles for this purpose.

**13.0.3** The conductor shall be pulled through come-along clamps to string the conductor between the tension locations.

**13.0.4** Conductor splices shall not crack or otherwise be susceptible to damage in the stringing operation. The Contractor shall use only such equipment / methods during conductor stringing which ensures complete compliance in this regard. All the joints including mid span joints on the conductor shall be of the compression type, in accordance with the recommendations of the manufacturer.

**13.0.5** All the joints or splices shall be made at least 15 meters away from the pole. No joints or splices shall be made in spans crossing over main roads, railways and small river spans. Not more than one joint per sub-conductor per span. After compressing the joint, the aluminum sleeve shall have all corners rounded; burrs and sharp edges removed and smoothed

The contractor shall remain fully responsible for the exact alignment of the line. If after erection, any tower is found to be out of alignment, the same shall have to be dismantled and re-erected after correction by the contractor at his own cost, risk and responsibility, including installation of fresh foundation, if felt necessary by the Owner.

**NB:- 0.5% is the non-accountable allowable wastage (for both sag &wastage) will be permitted**

## **14.0 SUPPLY OF TOWER STRUCTURES FOR THE TRANSMISSION LINES**

### **14.0.1 SCOPE**

This specification provides for design, proto fabrication, galvanizing and delivery FOR (destination) of line towers, tower structures( Narrow base& Mini-base in Urban areas and in cross country except special locations) / G.I (RS Joist) poles/ PSC pole, stubs, tower extensions, stub-templates, tower accessories (Hangers, U-bolts, bird guards, anti-climbing devices), bolts and nuts, step bolts, flat and spring washers etc. as described hereinafter in this volume.**For easy in transportation all GI joist/ channels should be made into two pieces (6&4, 6&5, 7&6 mts) with jointing GI channels plates etc as per sample drawing (which is indicative)**

**The preliminary survey work has already been done and the following towers have been decided.The contractor shall design the tower foundation in accordance to the loading parameters supplemented by OWNER. and the concreting shall be done by M-15 (1:2:4) gradeconcrete only.**

### **14.0.6 PIN INSULATORS**

**14.0.6.1** 33 Kv Pin Insulators :-IS-731/77 (Procelin Insulator for O/H power lines with nominal voltage greater than 1000 volts.

**14.0.6.2** 33 Kv GI Pin :- Confirming to IS-2486 Part-I/1971.

**14.0.6.3** 11 Kv Pin Insulators :- IS-731/77 (Procelin Insulator for O/H power lines with nominal voltage greater than 1000 volts.

**14.0.6.4** 11 Kv GI Pin :- Confirming to IS-2486 Part-I/1971.

#### **14.0.7 DISC –INSULATORS:**

##### **14.0.7.1 Insulator Strings**

Sl. No.	Particulars	Single Suspension string	Double suspension string	Single Tension string	Double Tension string
1.	No. of standard Discs (nos)				
	1. 33 KV	1X3	2X3	1X4	2X4
	2. 11 kV	1X2	2X2	1X3	2X3
2.	Size of Disc (33 Kv/11 Kv)	255X145	255X145	280x170	280x170

All the above materials must conform to the **schedules at C2 and C3**

##### **14.0.7.2 PORCELAIN GLAZE:**

Surfaces to come in contact with cement shall be made rough by sand glazing. All other exposed surfaces shall be glazed with ceramic materials having the same temperature coefficient of expansion as that of the insulator shell. The thickness of the glaze shall be uniform throughout and the colour of the glaze shall be brown. The glaze shall have a visible luster and smooth on surface and be capable of satisfactory performance under extreme tropical climatic weather

conditions and prevent ageing of the porcelain. The glaze shall remain under compression on the porcelain body throughout the working temperature range.

#### **14.0.7.3 METAL PARTS:**

Cap and Ball pins:

Twin Ball pins shall be made with drop forged steel and caps with malleable cast iron. They shall be in one single piece and duly hot dip galvanized. They shall not contain parts or pieces joined together, welded, shrink fitted or by any other process from more than one piece of material. The pins shall be of high tensile steel, drop forged and heat malleable cast iron and annealed. Galvanizing shall be by the hot dip process with a heavy coating of zinc of very high purity with minimum of 6 dips. The bidder shall specify the grade, composition and mechanical properties of steel used for caps and pins.

#### **14.0.7.4 SECURITY CLIPS:**

The security clips shall be made of phosphor bronze or of stainless steel.

#### **14.0.7.5 FILLER MATERIAL:**

Cement to be used as a filler material shall be quick setting, for curing Portland cement. It shall not cause fracture by expansion or loosening by contraction. Cement shall not react chemically with metal parts in contact with it and its thickness shall be as small and as uniform as possible.

#### **14.0.7.6 MATERIAL DESIGN AND WORKMANSHIP:**

- (a) All raw materials to be used in the manufacture of these insulators shall be subject to strict raw materials quality control and to stage testing quality control during manufacturing stage to ensure the quality of the final end product. Manufacturing shall conform to the best engineering practices adopted in the field of extra high voltage transmission. Bidders shall therefore offer insulators as are guaranteed by them for satisfactory performance on Transmission lines.
- (b) The design, manufacturing process and material control at various stages be such as to give maximum working load, highest mobility, best resistance to corrosion good finish, elimination of sharp edges and corners to limit corona and radio interference voltage

#### **14.0.7.7 INSULATOR SHELL:**

The design of the insulator shell shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. Shells with cracks shall be eliminated by temperature cycle test followed by temperature cycle test followed by mallet test. Shells shall be dried under controlled conditions of humidity and temperature.

#### **14.0.7.8 METAL PARTS:**

- a) The twin ball pin and cap shall be designed to transmit the mechanical stresses to the shell by compression and develop uniform mechanical strength in the insulator. The cap shall be circular with the inner and outer surfaces concentric and of such design that it will not yield or distort under loaded conditions. The head portion of the insulator or is under tension the stresses are uniformly distributed over the pinhole portion of the shell. The pinball shall move freely in

the cap socket either during assembly of a string or during erection of a string or when a string is placed in position.

- b) Metal caps shall be free from cracks, seams, shrinks, air holes, blowholes and rough edges. All metal surfaces shall be perfectly smooth with no projecting parts or irregularities which may cause corona. All load bearing surfaces shall be smooth and uniform so as to distribute the loading stresses uniformly. Pins shall not show any macroscopically visible cracks, insulations and voids.

#### **14.0.7.9 GALVANIZING:**

All ferrous parts shall be hot dip galvanized six times in accordance with IS: 2629. The zinc to be used for galvanizing shall conform to grade Zn 99.5 as per IS: 209. The zinc coating shall be uniform, smoothly adherent, reasonably light, continuous and free from impurities such as flux ash, rust stains, bulky white deposits and blisters. Before ball fittings are galvanized, all die flashing on the shank and on the bearing surface of the ball shall be carefully removed without reducing the designed dimensional requirements.

#### **14.0.7.10 CEMENTING:**

The insulator design shall be such that the insulating medium shall not directly engage with hard metal. The surfaces of porcelain and coated with resilient paint to offset the effect of difference in thermal expansions of these materials.

##### **14.0.7.10 (a) Specific Requirement for Insulators**

**The insulators shall conform in the following specific conditions of respective IS given in the table below**

<b>Insulator</b>	<b>Designation</b>	<b>Minimum mechanical</b>	<b>Minimum Creepage</b>
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			<b>failing load</b>	<b>distance</b>
<b>11 KV</b>	<b>Pin</b>	<b>Type-B of IS731</b>	<b>10 KN</b>	<b>320 mm</b>
	<b>Pin</b>	<b>Type-B of IS731</b>	<b>10 KN</b>	<b>580 mm</b>
<b>33 KV</b>	<b>Stay</b>	<b>Type-C of IS 1445</b>	<b>88 KN</b>	<b>57 mm</b>
<b>33KV/11KV</b>			<b>44 KN</b>	<b>41 mm</b>
<b>LT</b>	<b>Stay</b>	<b>Type-C of IS 1445</b>	<b>44 KN</b>	<b>41 mm</b>

#### **14.0.7.11 SECURITY CLIPS (LOCKING DEVICES)**

The security clips to be used as locking device for ball and socket coupling shall be 'R' shaped hump type to provide for positive locking of the coupling as per IS: 2486 (Part-IV). The legs of the security clips shall allow for sore adding after installation to prevent complete withdrawal from the socket. The locking device shall be resilient corrosion resistant and of sufficient mechanical strength. There shall be no possibility of the locking device to be displaced or be capable of rotation when placed in position and under no circumstances shall it allow separation of insulator units and fitting 'W' type security clips are also acceptable. The hole for the security clip shall be countersunk and the clip shall be of such design that the eye of the clip may be engaged by a hot line clip puller to provide for disengagement under energized conditions. The force required for pulling the clip into its unlocked position shall not be less than 50 N (5 Kgs.) or more than 500N (50 Kgs.)

#### **DISC INSULATORS (B & S Type)**



## GURANTEED TECHNICAL PARTICULARS

(To be submitted along with offer)

Sl. No.	Description	OWNER's Approved Standard	Bidder's Offer
1	Manufacturer's name		
2	Address of manufacturer		
3	Location of type testing		
4	Applicable standard		
5	Type of insulator (Porcelain or toughened glass)		
6	Dry impulse withstand voltage		
7	Wet power frequency, 1 minute, withstand voltage		
8	Dry, Critical Impulse Flashover Voltage		
9	Dry, power frequency, Critical Flashover Voltage		
10	Wet, power frequency, Critical Flashover Voltage		
11	Power frequency Puncture Voltage		
12	Mechanical Routine Test Load		
13	Mechanical Impact Strength		
14	Shattered Strength (Glass)		
15	Electromechanical Failing Load		
16	Safe Working Load		
17	Minimum Failing Load		
18	Creepage Distance		
19	Protected Creepage Distance		
20	Type and Grade of Materials : Insulator		
21	Type and Grade of Materials : Cap		
22	Type and Grade of Materials : Pin		
23	Type and Grade of Materials : Locking Pin		
24	Type and Grade of Materials : Cement		
25	Type of semi conducting Glaze		
26	Colour of Insulator		
27	Weight of Insulator		
28	Number of Insulators per Crate		
29	Gross Weight of Loaded Crate		
30	Whether drawing showing dimensional details have been furnished along with		

	Bid		
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**33 KV,11 KV PIN INSULATORS  
GURANTEED TECHNICAL PARTICULARS  
(To be submitted along with offer)**

Sl. No.	Description	OWNER's Approved Standard	Bidder's Offer
1	Manufacturer's name		
2	Address of manufacturer		
3	Location of type testing		
4	Applicable standard		
5	Type of insulator (Porcelain or toughened glass)		
6	Dry impulse withstand voltage		
7	Wet power frequency, 1 minute, withstand voltage		
8	Dry, Critical Impulse Flashover Voltage		
9	Dry, power frequency, Critical Flashover Voltage		
10	Wet, power frequency, Critical Flashover Voltage		
11	Power frequency Puncture Voltage		
12	Safe Working Load		
13	Minimum Failing Load		
14	Creepage Distance		
15	Protected Creepage Distance		
16	Type and Grade of Materials : Insulator		
17	Type and Grade of Materials : Thimble		
18	Type and Grade of Materials : Cement		
19	Type of semi conducting Glaze		
20	Radius of conductor Groove		
21	Colour of Insulator		
22	Weight of Insulator		
23	Number of Insulators per Crate		
24	Gross Weight of Loaded Crate		
25	Whether drawing showing dimensional details have been furnished along with Bid		
26	Whether Type Test Certificate have been furnished		

27	Other particulars (if any)		
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**HT STAY INSULATOR & LT STAY INSULATORS  
GURANTEED TECHNICAL PARTICULARS**

(To be submitted along with offer)

<b>Sl. No.</b>	<b>Description</b>	<b>OWNER's Approved Standard</b>	<b>Bidder's Offer</b>
1	Manufacturer's name		
2	Address of manufacturer		
3	Location of type testing		
4	Applicable standard & Type		
5	Type of insulator (Porcelain or toughened glass)		
6	Dry impulse withstand voltage		
7	Wet power frequency, 1 minute, withstand voltage		
8	Dry, Critical Impulse Flashover Voltage		
9	Dry, power frequency, Critical Flashover Voltage		
10	Wet, power frequency, Critical Flashover Voltage		
11	Power frequency Puncture Voltage		
12	Safe Working Load		
13	Minimum Failing Load		
14	Creepage Distance		
15	Protected Creepage Distance		
16	Type and Grade of Materials : Insulator		
17	Colour of Insulator		
18	Weight of Insulator		
19	Number of Insulators per Crate		
20	Type of semi conducting Glaze		
21	Minimum dia of Stay wire hole		
22	Whether drawing showing dimensional details have been furnished along with Bid		
23	Whether Type Test Certificate have been furnished		
24	Other particulars (if any)		

**GURANTEED TECHNICAL PARTICULARS**

(To be submitted along with offer)

Sl. No.	Description	Bidder's Offer	
		33 KV GI PIN	11 KV GI PIN
1	Manufacturer's name Manufacturer's name & Address		
2	Standard applicable specification		
3	Minimum failing load		
4	Dimensions (mm)		
A	Total length		
B	Shank length		
C	Stalk length		
5	Type of threads		
6	Threads per Inch		
7	Type of galvanization of pin & nuts		
8	Mass of zinc (minimum)		
9	Applicable specification		
10	No. of Nuts with each pin & its size		
11	No. of spring washer with each pin & its size		
12	Packing details		
A	Type of packing		
B	Weight of each pin approx, (with nut & washers)		
C	No. of Pins in each packing (Kg)		
13	Tolerance in weight / dimensions, if any		
14	I.S.I. Certificate License number		
15	Any other relevant information the bidder would like to indicate		
16	Manufacturer's Trade mark with each GS Pins		
17	Whether drawing has been submitted by the bidder		

#### 14.0.8 LONG ROD INSULATOR

33KV Long Rod Insulator in conformity to IS:2486 , IEC:433 & IS:731 can be used preferably in Saline affected area. The technical requirements are as under

- |    |                                       |        |
|----|---------------------------------------|--------|
| 1. | minimum nominal creepage distance     | 850 mm |
| 2. | Lightning impulse withstand voltage   | 170KVp |
| 3. | Wet Power Frequency withstand voltage | 75 KV  |
| 4. | Tensile load                          | 70KN   |

### MILD STEEL CHANNEL & ANGLE

Clause No.	TECHNICAL SPECIFICATIONS OF MILD STEEL CHANNEL & ANGLE															
1.00.00	<p><b>SCOPE</b></p> <p>This specification covers design, manufacture, testing and dispatch to owner's stores of M.S. Channel &amp; Angle for use in structures in distribution system.</p>															
2.00.00	<p><b>APPLICABLE STANDARD</b></p> <p>Materials shall conform to the latest applicable Indian standards. In case bidders offer steel section and supports conforming to any other international specifications which shall be equivalent or better than IS, the same is also acceptable.</p> <table border="0" style="width: 100%;"> <thead> <tr> <th style="text-align: left;">Sl.No.</th> <th style="text-align: left;">Standard No.</th> <th style="text-align: left;">Title</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>IS: 2062 Grade 'A'</td> <td>Quality Specification for</td> </tr> <tr> <td></td> <td>M.S.Angles,</td> <td>M.S.Channel</td> </tr> <tr> <td>2</td> <td>IS: 2062</td> <td>Chemical and Physical composition of material</td> </tr> <tr> <td>3</td> <td>IS: 1852</td> <td>Rolling and Cutting Tolerances for Hot Rolled Steel products</td> </tr> </tbody> </table>	Sl.No.	Standard No.	Title	1	IS: 2062 Grade 'A'	Quality Specification for		M.S.Angles,	M.S.Channel	2	IS: 2062	Chemical and Physical composition of material	3	IS: 1852	Rolling and Cutting Tolerances for Hot Rolled Steel products
Sl.No.	Standard No.	Title														
1	IS: 2062 Grade 'A'	Quality Specification for														
	M.S.Angles,	M.S.Channel														
2	IS: 2062	Chemical and Physical composition of material														
3	IS: 1852	Rolling and Cutting Tolerances for Hot Rolled Steel products														
3.00.00	<p><b>GENERAL REQUIREMENTS</b></p>															
3.01.00	<p><b>Raw material</b></p> <p>The Steel Sections shall be re-rolled from the BILLETS/INGOTS of tested quality as per latest version of IS:2830 or to any equivalent International Standard and shall be arranged by the bidder from their own sources. The Chemical composition and Physical properties of the finished material shall be as per the equivalent standards. Chemical Composition and Physical Properties of M.S. Angles, M.S. Channels, and M.S.Flat conforming to IS: Conforming to IS:2062/84</p>															
3.02.00	<p><b>Chemical Composition</b></p>															
3.03.00	<p><b>Chemical composition For Fe 410 WA Grade</b></p> <p>1 C - 0.23% MAX</p> <p>2 Mn - 1.5% MAX</p>															

	<p>3 S - 0.050% MAX  4 P - 0.050% MAX  5 SI - 0.40% MAX  6 CE  (Carbon Equivalent)- 0.42% MAX</p>
3.04.00	<p><b>Mechanical Properties</b></p> <p>1. Tensile strength Kgf/mm<sup>2</sup> - 410</p> <p>2. Yield stress Min. for thickness/diameter</p> <p>&lt; 20 mm - 26 Kgf/mm<sup>2</sup> OR 250 N/ mm<sup>2</sup></p> <p>20-40 mm - 24 Kgf/mm<sup>2</sup> OR 240 N/ mm<sup>2</sup></p> <p>&gt; 40 mm - 23 Kgf/mm<sup>2</sup> OR 230 N/ mm<sup>2</sup></p> <p>3. Elongation % - 23%</p> <p>4. Bend Test (Internal Dia) - Min-3t  (t—is the thickness of the material).</p>
3.05.00	<p><b>Tolerance</b></p> <p>Variation in ordered quantity for any destination and overall ordered quantity be only to the extent of ±2%.  Rolling and weight tolerances shall be as per version of IS: 1852 or to any equivalent International Standard.</p>
4.00.00	<p><b>TEST</b></p> <p>Steel Section shall be tested in IS approved Laboratory or Standard Laboratory the Bidder country having all facilities available for conducting all the test prescribed in relevant IS or IEC or to any equivalent International Standard or any recognized and reputable International Laboratory or Institutions.</p> <p>The bidders are required to specifically indicate that;</p> <p>They hold valid IS (or equivalent IEC) License.  Steel Section offered are bearing requisite IS certification or equivalent marks.</p> <p>The bidders are required to submit a copy of the valid IS (or equivalent IEC) License clearly indicating size and range of product against respective ISS or any equivalent International Standards along with their offer.</p>
5.00.00	<p><b>MARKING</b></p> <p>It is desirable that the bidder should put his identification marks on the finished material. The mark shall be in “legible English letter” given with marking dies of minimum 18 mm size.</p>

6.00.00	<p><b>INSPECTION AND TEST CERTIFICATES</b></p> <p>The material to be supplied will be subject to inspection and approval by the purchaser's representative before dispatch and/or on arrival at the destination. Inspection before dispatch shall not however, relieve the bidder of his responsibility to supply the Steel Sections strictly in accordance with the specification.</p> <p>The purchaser's representative shall be entitled at all reasonable time during manufacture to inspect, examine and test at the bidder's premises the materials and workmanship of the steel section to be supplied.</p> <p>As soon as the steel Section are ready for testing, the bidder shall intimate the purchaser well in advance , so that action may be taken for getting the material inspected. The material shall not be dispatched unless waiver of inspection is obtained or inspected by the purchaser's authorized representative.</p> <p>Test certificates shall be in accordance with latest version of the relevant Indian Standards or any equivalent International Standard.</p> <p>The acceptance of any batch/lot shall in no way relieve the bidder of any of his responsibilities for meeting all the requirements of the specification and shall not prevent subsequent rejection of any item if the same is later found defective.</p>
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## **15.0 FLEXIBLE COPPER BOND**

At suspension and tension towers, the earth wire suspension and tension clamps shall be securely bonded to the tower steelwork by means of a multi-strand flexible copper bond wire. The copper bond shall be sufficiently flexible to allow movement of the suspension clamp under all operating conditions and terminated with compression lugs.

The flexible copper bond shall be of nominal 34 sq.mm equivalent copper area and not less than 500 mm in length. It shall consist of 259 wires of 0.417 mm dia. tinned copper conductor. It shall be laid up as seven stranded ropes, each of 37 bunched wires. The tinning shall be as per IS 9567. Two tinned copper connecting lugs shall be press jointed to either ends of the flexible copper cable. One lug shall be suitable for 12 mm, dia. bolt and the other for 16 mm

dia. bolt. The complete assembly shall also include one 16 mm dia., 40 mm long mild steel bolt hot dip galvanised with nut and lock washers.

## 21.0 GENERAL TECHNICAL REQUIREMENTS FOR CIVIL WORKS

Design details - foundation  
 Line voltage - 33kV / 11 Kv  
 No. of circuits - Double/ Single

(a) Properties of soil for bidding purpose only

Sl. No.	Details	SoftLoose (normal dry)	Mud (Submerge d)	Hard Rock	Soft Rock	WBC
1.	Angle of repose of soil(in degree)	30	15	45	20-30	0
2.	Ultimate bearing strength of earth (T/M <sup>2</sup> )	11	5.5	87.0	50.0	

(b) Properties of concrete

Weight of foundation concrete 1:2:4 mix for design purpose shall be taken as 2400 kg/cu.m in dry location.

(c) Factor of safety for foundation against over turning due to up-lift and thrust.

- i) Normal condition 2.2
- ii) Broken wire condition 1.65

## 22.0 FOUNDATION GENERAL DESCRIPTION

Design, construction and other relevant drawings shall be furnished by the tower designer for all types of towers for Normal soil WBC soil.

## 23.0 TAKING OVER



Tower and tower accessories received at site stores are to be stored item-wise and mark-wise to facilitate joint inspection of the materials (with reference to packing list and detailed order).

If the materials/equipment or any part thereof is damaged or lost during the transit, the replacement of such materials shall be effected by the contractor timely so as to maintain programme of work. However, the line under erection shall be taken over by the purchaser only when the entire line is completed in all respect and made ready for commissioning at rated voltage. Partly erected line will not be taken over.

Taking over of the line shall be in no way relieve the contractor from his responsibility for satisfactory operation of the erected line in terms of the guarantee clause of the specification.

#### **24.0 MATERIALS HANDLING AND INSURANCE**

The contractor shall deliver all equipment/materials against this contract to his site stores under cover of Transit Insurance to be taken in his name. Cost of such insurance is to be borne by the contractor.

Cost of transportation of all materials from contractor's store to the site of work as well as department supply items like Transformers, Breakers, CT, PT, ACDB, Isolators, Conductors, AB cables, etc shall be borne by the contractor irrespective of mode of transportation and site condition.

The contractor has to bear the cost of premiums on insurance for all materials, tower accessories and total erection cost of the line including cement, rods for foundation.

It will be the responsibility of the contractor to report to the concerned Police Station about all incidents of thefts and lodge, pursue and settle all claims with

Insurance Company in case of damage/loss due to theft, pilferage, flood and fire etc. and the Owner of the work shall be kept informed promptly in writing about all such incidents. The loss, if any, on this account shall be recoverable from the contractor if the claims are not lodged and properly pursued in time or if the claims are not settled by the insurance company due to lapses on the part of the contractor. The contractor shall have to replenish promptly damaged, stolen tower members and accessories conductors, earth wire, hardware's etc. and repair/re-erect the damaged lines, free of cost to the Owner so as to maintain the programme of work. The Owner will not be responsible in any way for such loss of materials.

## 25.0 Check List

Before the line is offered for taking over and disbursement of final payment subsequent to the materials reconciliations a comprehensive format in shape of check list as shown at schedule C-4 must be filled up and signed by the executing agency.

### Schedule C 1 - Earth Wire ( In River crossing Spans)

<b>Description (Complete earth conductor)</b>	<b>Unit</b>	<b>GSW</b>
Appropriate Indian Standard No		398(Part-2)
Appropriate British Standard No		183
Material of earth conductor		galvanized steel
Number and diameter of wires	No./mm	7/3.15
Overall diameter of conductor	mm	9.45
Mass of conductor per kilometer	kg	428
Ultimate strength of conductor	Newton	56000
Lay length	mm	160 +/- 15

Direction of the lay of the outer layer		Right hand
Chemical composition of the steel wire	%	
Carbon		not more than 0.55
Manganese		0.4 to 0.9
Phosphorous		not more than 0.04
Sulphur		not more than 0.04
Silicon		0.15 to 0.35
Purity of Zinc for galvanizing	%	99.95
Galvanizing after stranding		
a) Minimum weight of Zinc coating per sq. m. of the uncoated wire surface	gms	240
b) Minimum no. of one minute dips that the galvanized wire can withstand in Standard Preece Test		3 and ½
Maximum length of conductor on drum #	km	4 +/- 5%
D.C. resistance at 20 °C	ohms/km	3.375

**Schedule C2 - Insulator Strings (Suspension Sets For 33 kV Lines )**

<b>Description</b>	<b>Unit</b>	<b>Single “I” Suspension Strings</b>	<b>Double “I” Suspension Strings</b>	<b>Pilot Suspension Strings</b>
Mechanical strength of the complete insulator string along with all hardware fittings	kN	45	2x45	45

Maximum voltage (in percentage) across any disc in the complete insulator string under phase to earth voltage *	%	20	20	20
Number of insulator units in each string **		3	2x3	3
Purity of Zinc used for galvanizing	%	99.95	99.95	99.95
Minimum No. of one minute dips the ferrous parts can withstand in Standard Preece Test	No.	6	6	6

**Schedule C3 - Insulator Strings ( Tension Sets For 33 kV Lines )**

<b>Description</b>	<b>Unit</b>	<b>Single Tension Strings</b>	<b>Double Tension Strings</b>
Mechanical strength of the complete insulator string along with all hardware fittings	kN	70	2x70

Maximum voltage (in percentage ) across any disc in the complete insulator string under phase to earth voltage *	%	22	22
Number of insulator units in each string **		4	2x4
Purity of Zinc used for galvanizing	%	99.95	99.95
Minimum No. of one minute dips the ferrous parts can withstand in Standard Preece Test	No.	6	6

### **SCHEDULE C - 4**

#### **CHECK FORMAT**

1. Excavation has been done as per approved drawing of Normal soil. **Yes/ No**
2. PCC has been done as per approved drawing. **Yes/ No**

3. RCC has been done as per approved drawing and as per required Qty. **Yes/ No**  
Rods has been provided.
4. laping of rods has been done as per standard (Minimum 40 D). **Yes/ No**
6. Good quality of shutters has been used. **Yes/ No**
6. Is there any honey-combs after removal of shutters observed. **Yes/ No**
7. If honey-combs observed, has been repaired by providing rich Concrete **Yes/ No**  
mixture after removal of loose ingredients.
8. Is there any deviation in alignment related to tangent tower. **Yes/ No**
9. Is there any deviation in verticality after concreting.( If any deviation **Yes/ No**  
In verticality of pole or tower, the contractor should re-cast the Foundation free of cost, otherwise it will not to be accepted)
10. Is there any deviation in bi-section of angles of the Angle tower **Yes/ No**  
before taking up the concreting of pole or structure.
11. All the GI bolts-nuts of required size with required spring washer **Yes/ No**  
has been provided.
12. All the bolts-nuts has been properly tightened ( after full tight 3 Nos. **Yes/ No**  
threads will be projected out)
13. Cooping of required height ( in case of Urban area it is 30 cm, in **Yes/ No**  
Cross country it is 75cm) has been done.
14. Painting of pole or structures has been done as per specification. **Yes/ No**
15. Split pins & "I" clips has been provided in each H/W fittings & **Yes/ No**  
Insulator strings.
16. All the accessories in each locations has been fixed properly. **Yes/ No**
17. Bird guard has been provided in each tangent towers. **Yes/ No**
18. Anti climbing devices has been provided in each locations. **Yes/ No**
19. All the jumpers has been properly tightened by providing **Yes/ No**  
Required nos. of PG clamps( 2 nos. PG clamps has to be Provided per each side)

20. All the insulators and H/W fittings used has been free from all Defects. **Yes/ No**
21. Equal phase to phase clearance has been maintained. **Yes/ No**
22. Minimum ground clearance from bottom most conductor (7 mts. in cross country & 9 mts. In road crossings) has been maintained in each span. **Yes/ No**
23. Curing has been done for 28 days. **Yes/ No**
24. Proper back filling has been done as per specification. **Yes/ No**
25. Required earthing has done in every locations. **Yes/ No**
26. Material utilization accounts has been furnished.( In each and every **Yes/ No**  
**No** Bills should have material accounts of both departmental supply items And contractor's supply items, except civil items, otherwise the bills Will not accepted).
27. Stay **Yes/ No**
28. Guarding at Road Crossing. **Yes/ No**
29. Clearance with intercepting lines. **Yes/ No**
30. Proper Jumpering. **Yes/ No**

## **CIVIL WORKS (SUB-STATION)**



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OF  
ERECTION & CIVILWORK**

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## **1.0 ERECTION WORK**

### **1.1 CIVIL WORKS**

Civil works includes the following items:

The scope shall generally cover sub- station structures, including gantries and equipment support structures and their foundations, cable trenches along with covers, cable trench crossings of road and rails, sump pits, marshalling box/control cubicle foundations, switchyard dressing and levelling, site clearance, soil investigation, roads, drains, fencing, gravel filling and, transformer foundations, firewalls, control room building, Any other items, not specifically mentioned here but required for the commissioning of substation shall be deemed to be included in the scope of this Specification. The scope shall further cover design, engineering, erection, testing and commissioning of all civil works at each substation. All civil works shall also satisfy the General Technical Clauses specified in other sections of this specification and as detailed below.

Excavation, dewatering, carriage of excavated earth, plain cement concrete (PCC), casting of reinforced cement concrete (RCC) foundations, super-structures for sub- station structures, equipment supports, their control cubicles, bus post supports, lighting poles and panels, brick and stone masonry, cable trenches, pipe trenches with necessary pre cast RCC removable covers, with lifting facility(In every 5 th slab) and sump pits, cable supports and their embedment in cable trenches and cable trench crossings road or rail track with backfilling complete as per drawings approved by CESU, shall be carried out by the contractor. The cable trenches inside the control room shall be provided with GI chequered plate with angle stiffeners at the bottom for mechanical strength and painting there of as per the standard practice.

The Contractor shall furnish all designs, (unless otherwise specified) drawings, labour, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and as per direction of the Engg In-charge .

The work shall be carried out according to the design/drawings to be developed by the Contractor, and approved by the GM o/o CPIO or supplied to the bidder by the Engg In-charge . For all buildings, structures, foundations etc. necessary layout, levels and details shall be developed by the Contractor

keeping in view the functional requirement of the plant and facilities and providing enough space and access for operation, use and maintenance based on the input provided by the Engg In-charge . Certain minimum requirements are indicated in this specification for guidance purposes only. However, the Bidder shall quote according to the complete requirements.

## **2.0 SOIL INVESTIGATION**

### **General**

The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate general as well as specific information about the soil profile/strata and the necessary soil parameters of the site in order that the foundations of the various structures can be designed and constructed safely and rationally. Foundation systems adopted by the contractor shall ensure that relative settlement shall be as per provision in IS 1904 and any latest IS and other Indian Standards.

A report to the effect will be submitted by the Contractor for the Engg In-charge specific approval giving details regarding his assumed data for Civil structures design.

Any variation in soil data shall not constitute a valid reason for any additional cost and shall not affect the terms and condition of the Contract. Nothing extra what so ever shall be paid to the Contractor on account of any variation in subsoil properties /or conditions. Tests must be conducted under all the critical locations i.e. Control room building & transformer location etc. However, some of the soil parameters given below for substations have to be determined and submitted to Engg In-charge .

- **Recommendation** The report should contain specific recommendations for the type of foundation for the various structures envisaged at site. The Contractor shall acquaint himself about the type of structures and their functions from the Engg In-charge . The observations and recommendations shall include but not be limited to the following :
- Recommended type of foundations for various structures. If piles are recommended the type, size and capacity of pile shall be given.
- Recommendations regarding slope of excavations and dewatering schemes, if required.

Recommendations for additional investigation beyond the scope of the present work, if Contractor considers such investigation necessary

## **2.1 EXCAVATION AND BACKFILL**

Excavation and backfill for foundations shall be in accordance with the relevant Code. Back filled materials in the pit to be levelled maximum up to a

height of 200-250 mm and then to be compacted to 150mm after sprinkling of required quantity of water.

Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.

## **2.2 Rock excavation**

The rock to be excavated shall be classified under the following categories :

### **1. Ordinary rock**

Rock which does not require blasting, wedging or similar means for excavation is considered as ordinary rock.. This may be quarried or split with crowbars or pickaxes and includes lime stone, sand stone, hard laterite, hard conglomerate and reinforced cement concrete below ground level. It will also include rock which is normally hard requiring blasting when dry but can be excavated without blasting, wedging or similar means when wet. It may require light blasting for loosening materials, but this will not any way entitle the material to be classified as hard rock.

### **2. Hard Rock (Blasting prohibited)**

This shall cover any hard rock requiring blasting as described in above but where blasting is prohibited for any reason and excavation has to be carried out by chiselling, wedging. drilling or any other approved method.

## **2.3 Authority for classification**

The classification of excavation shall be decided by the Engg In-charge and his decision shall be final and binding on the Contractor.

### **2.3.1 Excavations for foundations and other purposes**

Excavations shall be of the minimum sizes necessary for the proper construction of the works, and excavations shall not be kept open for periods longer than that reasonably required to construct the works. The Contractor shall take all precautions necessary to ensure that the bottoms of excavations are protected from deterioration and that the excavations are carried out in such a manner that adjacent foundations, pipes or such like are not undermined, damaged or weakened in any way. Any excavation taken out below the proper level without approval shall be made good at the expense of the Contractor using concrete or other material as directed.

### **2.3.2 Support of excavations**

The Contractor shall be responsible for the stability of the sides of the excavations. Excavation surfaces shall be close timbered or sheeted, planked and strutted as and when necessary during the course of the work and shall ensure the safety of personnel working within them. If any slips occur, they shall, as soon as practicable, be made good in an approved manner at the

expense of the Contractor. Shoring shall not be removed until the possibility of damaging the works by earth pressure has passed. No payment for shoring or timber left in shall be made, unless agreed in writing by the Engg In-charge .

#### **2.4 Works to be in dry**

All excavations shall be kept free from water and the Contractor shall take whatever action is necessary to achieve this. Pumping, hand dewatering and other means necessary to maintain the excavations free from water shall be at the expense of the Contractor, and carried out in an approved manner.

#### **2.5 Backfill**

As soon as possible after the permanent foundation works are sufficiently hard and have been inspected and approved, backfill shall be placed where necessary and thoroughly consolidated in layers not exceeding two hundred (200) millimetres in depth.

On completion of structures, the earth surrounding them shall be accurately finished to the line and grade as shown on the drawings. Finished surfaces shall be free of irregularities and depressions.

The soil to be used for back filling purposes shall be from the excavated earth or from borrowed pits, as directed by the Engg In-charge .

#### **2.6 Disposal of surplus**

Surplus excavated material not required or not approved for backfilling shall be loaded and deposited either on or off site as directed. The Contractor shall not delay disposal of surplus material after receipt of instructions from the Engg In-charge .

#### **2.7 Requirement for fill material under foundations**

The thickness of fill material under the foundations shall be such that the maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil.

Where compacted fill is required it shall consist of suitable sand, or other selective inorganic material, RRHG mixed with sand subject to approval by the Engg In-charge . The filling shall be done with locally available sand. The filled in sand shall be kept immersed in water for sufficient time to ensure compaction, if so desired by the Engg In-charge .

### **3.0 SITE LEVELLING**

#### **3.1 Scope of Work**

The contractor shall furnish all labour, equipment and materials required for complete performance of the work in accordance with the drawings, specification and direction of the Engg In-charge .Contour survey of proposed sub-station area including the control room area has to be done by taking

levels at an interval of two meters in both the ways in the presence of JE / SDO. The detail contour survey should be traced over the tracing graph paper and after duly signed by JE and SDO has to be submitted to concern Executive / Divisional engineer for approval. The concern EE/ DE will approve the contour after taking decision of height of the ground level to be maintained by considering the HFL, surrounded land scape, etc with minimum cutting and filling if any.

### **3.2 General Requirement**

The material required for site surfacing/gravel filling shall be free from all types of organic materials and shall be of standard approved quality, and as directed by the Engg In-charge .

The Contractor shall furnish and install the site surfacing to the lines and grades as shown in the drawing and in accordance with the requirements and direction of the Engg In-charge . The soil of the entire switchyard area shall be levelled before placing the site surfacing/gravel fill material. After all the structures and equipment have been erected and accepted the site shall be maintained to the lines and grades indicated in the drawing and rolled or compacted with suitable water sprinkling to form a smooth and compact surface condition, which shall be matching with finished ground level of the switchyard area. After due compaction of the surface of the entire switchyard area shall be provided with plain cement concrete of 75 mm thickness (1:4:8) mix. after proper compaction. Care shall be taken for proper gradient for easy discharge of storm water.

After the PCC is applied and surface prepared to the required slope and grade a base layer of uncrushed/crushed broken gravel of 20 mm nominal size shall be spread, rolled and compacted to a thickness 100 mm. The 20 -40 mm. nominal size (for both layers) shall pass 100% through IS sieve designation 37.5 mm and nothing through 16.0 mm. IS sieve.

Engg In-charge by no means shall relieve the contractor of their contractual obligations as stipulated in General and Special Conditions of Contract.

## **4.0 SITE DRAINAGE**

### **4.1 General**

Adequate site drainage system (By using 1<sup>st</sup>. class Brick masonry of 1:5 cement mortar, PCC 1:4:8 & 1:2:4 ratio, Cement plastering & punning) shall be provided by the Contractor. The Contractor shall obtain rainfall data and design the storm water drainage system, (culverts, ditches, drains etc.) to accommodate the most intense rainfall that is likely to occur over the

catchments area in one hour period on an average of once per ten years. The surfaces of the site shall be sloped to prevent the ponding of water.

The Contractor shall ensure that water drains are away from the site area and shall prevent damage to adjacent property by this water. Adequate protection shall be given to site surfaces, roads, ditches, culverts, etc., to prevent erosion of material by water.

The drainage system shall be adequate without the use of cable trenches.

All manholes deeper than 1.2 m shall be provided with galvanised M.S. foot rests. Foot rests shall be of 20 mm M.S. square bars.

Open storm water drains shall be provided on both sides of the roads and shall be designed to drain the road surface as well as all the free and covered areas.

Invert of the drainage system shall be decided in such a way that the water can easily be discharged above the High Flood Level (HFL) outside substation boundary at suitable location and approved by Engg In-charge . Pumping of drainage water, if required, shall be provided by Contractor.

All internal site drainage systems, including the final connection and disposal to Engg In-charge acceptance points shall be part of Contractor's scope including all required civil work, mechanical and electrical systems. The Contractor shall connect his drain(s) at one or more points.

Suitable pumping arrangement shall be provided by the Contractor to pump out the water from sump to the open channel; automatic float valve type pump shall be provided and installed by Contractor.

The Contractor shall locate the outfall point outside the substation vicinity and the substation storm drainage must be connected to this point.

The drainage scheme and associated drawings shall be subject to approval of the Engg In-charge .

#### **4.2 Excavation and backfill**

Trench excavations for drains shall be carried out with the minimum disturbance to adjacent ground and in such a way that existing or new work shall not be undermined. No backfill shall be placed until it has been inspected, tested and approved. Backfill shall be carefully placed by hand tools and rammed in layers not exceeding one hundred (100) millimetres thick in a manner which will not cause damage.

### **5.0 SEWAGE SYSTEM ( AT URBAN SUB-STATION)**

A sewage system shall be provided for all utility buildings including the Control room building and other auxiliary buildings.

The Contractor shall construct suitable septic tank and soak pit for the discharge of effluents.

Sewers shall be designed for a minimum self cleansing velocity of 0.6m/sec and the maximum velocity shall not exceed 2.4m/sec.

The sewage system shall consist of all necessary piping, pumps, if required, fittings, manholes, clean - outs, piping connections and all other materials required for safe and efficient sewage collection. Sewer pipes and fittings shall conform to the relevant Indian Standards.

Cast iron pipes shall be used below ground level for sewage disposal.

## **5.1 ROADS AND CULVERTS**

The Contractor shall be responsible for constructing approach roads, sub-station roads and service roads etc. within the substation area. Layout of the roads shall be based on general details and arrangement drawings for the substation. Roads to the transformer bays shall be as short and straight as possible. The roads shall be with 3.75 mts. In width.

Finished top (crest) of roads shall be a minimum of 300 mm above the surrounding grade level (Formation level).

### **A) CONCRETE ROAD:**

All the roads in front of Transformer shall be of concrete road. The other approach roads should be black topping. In case of switch yard road (concrete road) the shoulder would be compacted earth 600 mm wide on the sides of the road. The concrete road shall have 100 mm thick PCC (1:2:4 nominal ratio). Below it 100 mm thick PCC (1:4:8) shall be provided. 300 mm thick water bound macadam (WBM) in three equal layers of 100 mm each at the bottom.

The road within the switch yard area the PCC and WBM shall placed only up to the width of the road. Expansion joints (12mm thick) shall be provided at every 5 mtrs.

### **B) BITUMINOUS ROAD:**

The approach road beyond the concrete road shall be bituminous type. The following procedure shall be followed for the construction of bituminous roads.

1. Compacted WBM at the bottom end of the road up to a thickness of 300 mm in three equal layers 100 mm each. The compaction shall be done by laying stone aggregates of size 100mm. each layer shall be laid and compacted with water spreading and using rollers as per the standard practice adopted in the CPWD guide line.
2. Above, the compacted WBM 1st filling as stated under (1), 200 mm thick consolidated WBM in two layers with stone aggregates of size 90 – 45mm shall be laid. Each layers shall be laid and compacted with water spreading and using rollers as per recommended.



3. Above the compacted 2nd layer of WBM, 75 mm thick consolidated WBM in two layers with stone aggregates of size 63mm-45mm shall be laid. Each layers shall be compacted with water spreading and using rollers as per recommended.
4. Above the compacted 3rd layer of WBM, 75 mm thick consolidated WBM in two layers with stone aggregates of size 53mm-22.4mm shall be laid. Each layers shall be compacted with water spreading and using rollers as per recommended.
5. Above the 4th layer of compacted WBM, 25mm thick pre mix carpet surfacing has to be done. The carpet surfacing shall be done with 2.25 cum and 1.12 cum of stone chippings of 13.2 mm size and 11.2 mm size respectively per 100 sq mtrs and 52 Kgs of hot bitumen per cum of stone chippings. Complete with paving ASPHALT 80/100 heated and thin mixed with solvent @70g/Kg of ASPHALT. Hot bitumen of grade 80/100 shall be spread on road surface @750g/Kg per sqmtr. There shall be shoulder on both side of the roads as per given data. The curvature of the road shall be R=7M and additional metal ling for turning has to be maintained. The shoulder shall also be made compacted morrum filling and other as specified.

## **6.0 TRANSFORMER FOUNDATION, RAIL TRACK**

### **6.1 General**

All the transformer foundations should be designed for 12.5 MVA Power transformer in Urban areas ,for 8 MVA Power transformer sub urban areas and for 5 MVA power transformers in other areas & shall be of RCC, M15 (1:2:4 mix) grade (as per the indicative drawing enclosed). The rails shall be first quality 52 kg/m medium manganese steel as per Indian Railway specification T-12-64.

The station transformer (Owner supply materials) has to be column mounted with provision of LA , HG Fuse, AB Switch etc. has to be done by the contractor.

### **Oil Recovery System**

### **6.2 General**

An oil recovery system shall be provided for all transformers (containing insulating oil or any flammable or polluting liquid) in order to avoid spread of fire by the oil, and for environmental protection by providing suitable common sump pits which can accommodate 125% oil of one of the 12.5/8/5 MVA Transformer. The required drawing should be approved by Engineer in charge before taking up the foundation work.

## **7.0 FIRE PROTECTION WALLS**

### **7.1 General**

Fire protection walls shall be provided in accordance with Tariff Advisory Committee (TAC) recommendations.

### **7.2 Application criteria**

A fire wall shall be erected between the transformers if the free distance between the various pieces of equipment is less than 10 m, to protect each one from the effects of fire on another.

Fire walls shall also be erected between the power transformers if the free distance is less than ten metres.

### **7.3 Fire resistance**

The fire wall shall have a minimum fire resistance of three hours. Fire walls shall be designed in order to protect against the effect of radiant heat and flying debris from an adjacent fire. The column of the fire walls shall be RCC, M15 (1:2:4 mix).

### **7.4 Dimensions**

Fire walls shall extend at least two metres on each side of the power transformers and at least one metre above the conservator tank or safety vent. These dimensions might be reduced in special cases where there is lack of space.

## **8.0 BOUNDARY WALL/ COMPOUND WALL:**

The scope includes the design, engineering and construction of the boundary wall all along the property line of CESU on each sub-station.

The 250 mm wide boundary shall be constructed to a height of 2.0 mtrs above finished gravel level on of the substation area and below virgin soil a minimum of 900 mm depth. Expansion gap @ 10-15mm at an interval at 10 mtr along the periphery be provided. 2 inch iron nail bed to be provided in (ratio 1:2:4) shall be provided on the top of the boundary wall.

- A)** The below mentioned brick works is for construction of pillar where the Y shaped frame shall be grouted.

Inside the Virgin soil:-

The masonry work in foundation and plinth shall be done in 1:5 cement mortar above a layer (height of 75mm and width of 900 mm as per requirement) of cement concrete 1:3:6. The Brick work shall be as below.

#### **i. Inside the Virgin soil:-**

First layer above the PCC of 75 mm: Height: 300mm & Width: 750 mm (as per requirement)

Second layer above first layer brick: Height: 300mm & Width: 625 mm (as per requirement)

Third layer above second layer brick: Height: 300mm & Width:500 mm (as per requirement)

**ii Above ground level:**

DPC of 50 mm above the third layer of Brick work.

Brick work of thickness of 250 mm having height of 2.5 mtrs.

Expansion joint shall be provided at 10 mtr interval of the boundary wall and in every 2.5 mts. 375x375 pillars of Brick masonry has to be provided.

The even face of the brick work shall be plastered with 12mm thick in 1:6 cement sand and uneven face shall be plastered with 18mm thick in 1:6 cement sand (in two layers) above the ground level.

Both faces of the walls shall be provided with two coats of cement painting (weather proof) using approved quality of cement paint.

Boundary shall have one main gate as per stipulation elsewhere in the spec.

The gate shall be supported by gate pillars of RCC (1:1.5:3).A separate wicket gate shall be provided adjacent to the main gate.

In case the stability of the boundary wall as mentioned is not suitable for the soil, the bidder has to consider for putting RCC(1:1.5:3) tie beam to be rested on the RCC pillars. The size of the beam and pillar has to be carried out as per the soil condition for proper stability of the boundary walls.

## **9.0 CABLE TRENCHES**

### **9.1 General**

The cable trenches should be primarily of Brick masonry `supported with RCC pillars 250\*250mm at an interval of 2500mm over 75 mm RCC base. In each pillar, 2 nos of MS flats of 50\*6\*200mm shall be suitably embedded to hold 2nos of cable racks. The cable trench wall inside the control room will be of 100mm thick RCC only. The top of the cable trench should be RCC to hold the RCC covers (as per the approved drawing, enclosed). For main power cables separate cable trench should be made.

Cable trenches and pre-cast removable RCC covers (with lifting arrangement) shall be constructed using RCC of M15 grade.

The cable trenches shall be designed for the following loads.

- Dead load of 155 kg/ m length of cable support plus 75 kg on one tier at the end.
- Cable trench covers shall be designed for (i) self weight of top slab plus concentrated load of 200 kg at centre of span on each panel and a surcharge load of 2 tonnes per sq. metre.

Cable trench crossings of roads should be designed accordingly and to be submitted to EE/DE for approval. Trenches shall be drained. Necessary

sumps be constructed and sump pumps shall be supplied. Cable trenches shall not be used as storm water drains.

The top of trenches shall be kept at least 300 mm above the finished ground level (FGL). The FGL means the finish level of the soil but not the top of metalling surface. The top of cable trench shall be such that the surface rain water does not enter the trench.

All metal parts inside the trench shall be connected to the earthing system.

Cables from trench to equipments shall run in hard conduit pipes (GI pipe and necessary G.I bends and sockets)

A suitable clear gap shall be maintained between trench walls and foundations.

A clear (vertical) space of at least 200 mm shall be available for each tier in cable trench. From trench bed to lowest tier, a minimum clearance of 100 mm shall be available for all tier trench. The spacing between stands (cable tray supports) shall be 2000mm.No sharp bending of cable trench is permissible, it should be done as per 15D principle.

The trench bed shall have a slope of 1/500 along the run and 1/250 perpendicular to the run.

Cable tray supports (all galvanised structures) shall be designed and constructed to be a single complete fabrication or assembly such that every layer of the horizontal cable tray supports are fixed, either bolted or welded, to a vertical steel support that is embedded in the concrete wall of the cable trough. It shall not be permitted to embed a horizontal support beam directly into the wall of the trough in order to use the concrete wall as a means of load bearing.

Concrete troughs shall be provided with concrete covers of suitable load bearing strength. Where the cable troughs are run across or within 3 m of substation roads, the trough covers shall be capable of bearing an accidental wheel load of 20 kN. The drawings showing the details of fixing of cable racks in concrete cable trench walls, fixing of cable tray, no. of layers to be provided has to be provided by the contractor and to be get approved by the GM o/o CPIO.

**NB :- All the relevant drawings related to construction of Sub-station should submitted within 15 days from the detail work order to the concern Engineer in charge positively.**

The thickness of the RCC wall of the trench shall be 100mm and thickness of the raft shall be 75mm. All the frames for fixing of cable trays shall be of hot dip galvanized. A running earth strip has to run all through the cable trench for

proper earthing of the cable trays and stand (frame).The size of the earth strip is of 50X6mm G.I flats. Welding the GI flats to the frame to be carried out. Earthing strips to be welded with the running earth mat at 10mtrs interval.

The bidder also to supply and fix G.I perforated cable trays (of thickness 2mm) of appropriate size before laying of cables on the cable tray stand.

The covers of the slab are also of RCC with ratio mixing 1:2:4. The thickness of the slab shall be 50 mm (MS Rods to be used 8mm), The MS rods to be used shall be placed at 100 mm centre to centre both way and properly bided .The cover slab shall have provision of lifting hooks at two points for easy lifting of the slabs. Slabs having lifting hooks shall be placed at every 10<sup>th</sup> slabs, it should remain inside the top of concrete surface of the slab.

The covers for the cable trench inside the control room shall be provided with GI chequered plate with MS angle stiffeners at the bottom for proper mechanical strength.

Once the trench covers have been made they are to be stored and not laid until all trench cabling, is finished. Any covers laid before this time which become damaged shall be replaced at the Contractor's expense.

Trench covers and bridging beams for covers, except where heavy duty, shall be light enough for two men to lift.

## **9.2 Buried cables**

Cables are to be laid in neat lines and at suitable levels. Their depth below ground level will depend upon the voltage associated with the cables but in all cases the excavation must provide a clear trench. Sand filling below, around and above the cables will always be required and protection covers or tiles /bricks will be placed in position over the sand filling before final backfilling to the ground level. The line of the cable trenches shall be marked with suitable posts as required by relevant section of this Specification.

## **10.0 FOUNDATION DESIGN**

### **10.1 General**

All foundations shall be of reinforced cement concrete. The design and construction of RCC structures shall be carried out as per IS 456 and minimum grade of concrete shall be M15 corresponding to 1:2:4 nominal mix ratio with 12-20 mm coarse aggregate. Higher grades of concrete than specified above may be used at the discretion of the Bidder without any financial implication to the owner.

Limit state method of design shall be adopted unless stated otherwise in the Specification.

For design and construction of steel-concrete composite beams IS: 11384 shall be followed.

For detailing of reinforcement IS 2502 shall be followed. Cold twisted deformed bars ( $F_y = 415$  N/sq mm) conforming to IS 1786 shall be used as reinforcement. However, in specific areas, mild steel (Grade 1) conforming to IS 432 can also be used. Two layers of reinforcement (on inner and outer face) shall be provided for wall and slab sections having thickness of 150 mm and above. Clear cover to reinforcement towards the earth face shall be minimum 40 mm.

The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and /or equipment and /or superstructure, and other conditions which produce the maximum stresses in the foundation or the foundation component, and as per the relevant IS Codes of foundation design. The design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used.

All foundations shall rest below virgin ground level and the minimum depth of foundation below the virgin ground level (minimum one meter below the virgin ground level) shall be maintained.

Design shall consider any sub-soil water pressure that may be encountered.

Necessary protection to the foundation work, if required, shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental or harmful to the concrete foundations.

RCC columns shall be provided with rigid connection at the base.

All building sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be as stated in relevant IS Codes or as stipulated elsewhere in the Specifications.

Earth pressure for all underground structures shall be calculated using coefficient of earth pressure at rest, coefficient of active or passive earth pressure (whichever is applicable).

The following conditions shall be considered for the design of water tanks, pump houses, channels, sumps, trenches and other underground concrete structures such as basements etc.

- Full water pressure from inside and no earth pressure, ground water pressure and surcharge pressure from outside (applicable only to structures which are liable to be filled with water or any other liquid).
- Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

The Twin pole and equipment foundations shall be checked for a factor of safety of 2.2 for normal condition and 1.65 for short circuit condition against sliding, overturning and pullout. The same factor shall be used as partial safety factor over loads in limit state design also.

All underground concrete structures such as basements, pump houses, water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to IS 9103. In addition, the limit on permeability as given in IS 2645 shall also be met. The concrete surface of these structures in contact with earth shall also be provided with two coats of bituminous painting for water /damp proofing.

In case of water leakage in the above structures, leakage repair shall be achieved by the injection method.

### **10.2 Other Foundations**

All foundations shall be designed in accordance with the provisions of the relevant parts of latest revisions of IS 2911 and IS 456.

Type of foundation system i.e. isolated footing, raft or piling shall be decided based on the load intensity and soil strata.

Twin Pole foundations shall be designed for an additional factor of safety of 1.1 for normal/ broken wire conditions and for short circuit condition.

Circuit breaker foundations shall be designed for impact loading and shall be strictly in accordance with the Manufacturer's recommendations.

Switchyard foundation plinths and building plinths shall be minimum 300 mm and 500 mm above finished ground level respectively or as per minimum required safety electrical clearance stipulated in IE Rule.

### **10.3 Cement**

The cement to be used shall be the best quality of its type and must not be more than 3 months old in stock.

All cement shall be sampled and tested in accordance with Indian Standards.

The Portland cement used in concrete shall conform to IS 269.

Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation to be carried out by the contractor.

High Alumina cement shall NOT be used.

### **10.4 Aggregate**

Coarse and fine aggregate shall conform to the requirements of IS 383-1970.

Sampling and testing of aggregates shall be in accordance with the relevant Indian Standard.

Fine and coarse aggregates shall be obtained from the same source and the Contractor shall ensure that material from the source is known to have a good service record over a long period of time.

Aggregate shall be hard and dense and free from earth, clay, loam and soft, clayey, shaley or decomposed stone, organic matter and other impurities.

**10.5 Storage of aggregates**

Coarse and fine aggregates shall be stored on site in bins or on clean, dry, hard surfaces, and be kept free from all sources of contamination. Aggregates of different gradings shall be stored separately, and no new aggregate shall be mixed with existing stocks until tested, and approved by the Engg In-charge .

**10.6 Water**

Water used for mixing concrete and mortar shall be clean, fresh water obtained from an approved source and free from harmful chemicals, oils, organic matter and other impurities. Normally potable water may be considered satisfactorily for mixing and curing concrete and masonry work.

**10.7 Steel bar reinforcement**

Reinforcement shall comply with the appropriate Indian Standards.

All bar reinforcement shall be hot rolled steel except where the use of cold worked steel is specified on the drawings or otherwise approved.

The bars shall be round and free from corrosion, cracks, surface flaws, laminations, rough, jagged and imperfect edges and other defects.

The bar reinforcement shall be new, clean and of the lengths and diameters described on the Drawings and Schedules. Bars shall be transported and stored so that they remain clean, straight, undamaged and free from corrosion, rust or scale. Bars of different diameters shall be separately bundled.

**10.7 Welding of reinforcement**

Spot or tack welding for positioning bars in heavily reinforced areas will only be allowed with the express permission of the Engg In-charge . Extension of lengths of reinforcement by welding will not be permitted.

Welding will be approved only in low stress members, and lap welding will not be approved in any circumstances.

**10.9 Fixing of reinforcement**

Before fixing in the works bars shall be seen to be free from pitting, mud, oil, paint, loose rust or scale or other adherents harmful to the bond or strength of the reinforcement. Bars shall be fixed rigidly and accurately in position in accordance with the working drawings, unless otherwise approved by the Engg In-charge . Reinforcement at all intersections shall be securely tied together with 1.5 mm soft annealed tying wire the ends of which shall be cut and bent inwards. Cover to the reinforcement shall be in accordance



permissible standard and sufficient spacers and chairs of precast concrete of approved design shall be provided to maintain the specified cover and position. No insertion of bars in previously placed concrete shall be permitted. Projecting bars shall be adequately protected from displacement. The fixing of reinforcement in the works shall be approved by the Engg In-charge before concrete is placed. Measurement will be based on the calculated weights of steel actually used in tonnes corrected to second place of decimal.

#### **Concrete cover to reinforcement**

For durability the minimum concrete cover to any reinforcing bar shall be as follows:

##### **Concrete above ground.**

- Internal faces of slabs 25 mm
- Internal faces of beams and walls 30 mm
- Exposed faces of slabs, beams and walls 50 mm
- All faces of columns 50 mm

##### **Concrete below ground (including piles).**

- Faces in contact with soil including blinding concrete 75 mm
- All other faces (i.e. internal faces of basement wall) 50 mm

Only concrete or steel spacers shall be used to achieve the required minimum thickness of concrete cover to reinforcement. Concrete spacers shall have non metallic ties. Timber blocks for wedging the steel off the formwork will not be allowed.

#### **10.10 Formwork**

Formwork shall be constructed from timber, metal, lined as necessary for special finishes and designed with the quality and strength required to ensure rigidity throughout placing, ramming, vibration and setting of the concrete, without detrimental effect.

Formwork shall be erected true to line, level and shapes required using a minimum of approved internal ties. Faces in contact with the concrete shall be true and free from defect, jointed to prevent loss of water or fines, in panels or units which permit easy handling. Ties or spaces remaining embedded shall have the minimum cover specified for reinforcement. Forms for exposed concrete beams, girder casings and columns shall provide for a twenty five millimetre chamfer on external corners.

Wedges and clamps shall be kept tight during vibration operations. Before commencement or resumption of concreting, the interior of forms shall be cleaned and free of sawdust, shavings, dust, mud or other debris and openings shall be formed to facilitate this cleaning and inspection. The inside

of the forms shall be treated with a coating of an approved substance to prevent adhesion. Care shall be taken to prevent this substance being in contact with the reinforcement.

#### **10.11 Grades of concrete**

Concrete shall be either ordinary or controlled and in grades designated M10, M15, M20 and M25 as specified in IS: 456 (latest edition). In addition, nominal mixes of 1:3: 6 and 1: 4: 8 of nominal size 40 mm maximum, or as indicated on drawings, or any other mix without any strength requirements as per mix design shall be used where specified.

##### **Ordinary concrete**

Ordinary concrete shall be used for all plain cement concrete work and where shown on drawings or allowed by the Engg In-charge . Ordinary concrete shall not require preparation of trial mixes.

In proportioning concrete, the minimum quantity of cement shall be as specified in of this clause and the amount to be used shall be determined by actual weight. The quantities of fine and coarse aggregate may be determined by volume, but preferably by weight.

The water cement ratio shall not be more than those specified in IS 456.

Grade of Concrete	Minimum cement content per c.m. of finished concrete
M 10	236 kg
M 15	310 kg
M 20	400 kg

As a guide to perform the mix design properly, the relationship between water cement ratio, aggregate to cement ratio, workability and strength of concrete will be as per relevant IS.

The cement /total aggregate ratio is not to be increased beyond 1: 9.0 without specific permission of the Engg In-charge . It should be noted that such high aggregate/cement ratios will be required for concretes of very low slump and high water cement ratios which may be required to be used in mass concrete work only.

The actual cement aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used, and from trial mixes.

### 10.12 Strength requirements

The mix proportions for all grades of concrete shall be designed to produce the grade of concrete having the required workability and a characteristic strength not less than the value given below:

Grade Designation	Characteristic Compressive Strength at 28 days
M 10	10 N / sq. mm
M 15	15 N / sq. mm
M 20	20 N / sq. mm

The strength of concrete given above is the 28 days characteristic compressive strength of 15 cm cube.

The placing of concrete shall be a continuous operation with no interruption in excess of 30 minutes between the placing of continuous portions of concrete. When fresh concrete is required to be placed on previously placed and hardened concrete, special care should be taken to clean the surface of all foreign matter. For securing a good bond and water tight joint, the receiving surface should be made rough and a rich mortar placed on it unless it has been poured just before. The mortar layer should be about 15 mm thick with cement and sand proportion as that of the mix in use, and have the same water-cement ratio as the concrete to be placed.

After the concrete has been placed it shall be thoroughly compacted by approved mechanical vibration to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators must be operated by experienced men and over vibration shall not be permitted. Care should be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or disturbed during placing of concrete. No concrete shall be placed in open while it rains. If there is any sign of washing of cement and sand, the concrete shall be entirely removed immediately. Slabs, beams and similar structure shall be poured in one operation normally. In special circumstances with the approval of Engg In-charge these can be poured in horizontal layers not exceeding 50 cm. in depth. When poured in layers, it must be ensured that the under layer is not hardened. Bleeding of under layer if any shall be effectively removed.

### **10.13 Compaction of Concrete**

Compaction is necessary for production of good concrete. After the concrete has been placed it shall be thoroughly compacted by approved mechanical vibrator to a maximum subsidence without segregation and thoroughly worked around reinforcement or other embedded fixtures into the correct form and shape. Vibrators must be operated by experienced men. Care should be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or disturbed during the vibration of the concrete. The Contractors shall provide standby vibrators. Vibration is commonly used method of compaction of concrete, the use of mechanical vibrators complying with IS 2505, IS 2506, IS 2514 and IS 4656 for compacting concrete is recommended. For all practical purposes, the vibration can be considered to be sufficient when the air bubbles cease to appear and sufficient mortar appears to close the surface and facilitate easy finishing operations. The period of vibration required for a mix depends upon the workability of the mix.

### **10.14 Curing of Concrete**

In order to achieve proper and complete strength of the concrete, the loss of water from evaporation should be prevented. Eighty to eighty five per cent of the strength is attained in the first 28 days and hence this 28-day strength is considered to be the criterion for the design and is called characteristic strength. The concrete after setting for 24 hours shall be cured by keeping the concrete wet continuously for a period of 10 days after laying.

The curing increases compressive strength, improves durability, impermeability and abrasion resistance. Failure to carry out satisfactory curing can lead to cracking in the concrete. This in turn can lead to salt attack of the reinforcement and consequential failure of the structure. If cracks occur in a structure which are severe enough to affect the structure, the Contractor shall cut out and replace the defective concrete at his own cost. The Contractor's attention is, therefore, drawn to this particular aspect of proper and adequate curing

### **10.15 Removal of formwork**

Formwork shall be kept in position fully supported, until the concrete has hardened and gained sufficient strength to carry itself and any loads likely to be imposed upon it. Stripping must be effected in such a manner and at such a time that no shock or other injury is caused to the concrete. The responsibility for safe removal rests with the Contractor but the Engg In-charge may delay the time of striking if he deems it necessary.

Minimum periods, in the absence of agreement to the contrary, between completion of concreting and removal of forms are given below but due regard must be paid to the method of curing and prevailing conditions during this period.

Removal of forms are to be done as under

- |   |        |
|---|--------|
| i) Sides of foundations, columns, beams and wall  | 2days  |
| ii) Under side of slabs up to 4.5 m span  | 7days  |
| iii) Under side of slabs above to 4.5 m span<br>and underside of beams and arches up to 6m span | 14days |
| iv) Under side of beams and arches above 6m and up to 9m span                                   | 21days |

## **11.0 FENCING**

### **11.1 General**

Fencing shall be designed for the most critical loading combination taking into account wind forces, stability, tension on wires, minimum requirements as per this clause and relevant IS recommendations.

The un-climbable or security, or anti-intruder fencing shall consist of chain link mesh, all as shown on the drawings and as specified, supported on approved sections of structural steel. The posts shall be erected truly vertical, and all posts and struts shall be set in concrete block foundations.

### **11.2 Product materials**

#### **11.2.1 General**

Chain Link fence fabric in accordance to IS: 2721, and shall also meet the following requirements.

- Size of mesh 75 mm
- Size of coated wire 3.15 mm diameter
- Width of chain link 2000 mm
- Class of zinc coating medium

The posts shall be of medium M.S tube of 50 mm diameter conforming to Yst-22 (Kg / sq. mm). The tubes shall be also confirm to IS:1161/IS 806. The length of the tubular post shall be 3200mm.

An M.S base plate of size 160X160X6mm thick shall be welded with the tubular post. The post shall be provided on the top with M.S plate.

The tubular post shall be welded with 8 numbers of M.S flat of size 50X6mm – 75 mm long. Two numbers of 13.5 mm dia holes on each cleats shall be provided to bolt the fence fabric panel. The cleats shall be welded at equal spacing in such a way that 4 nos of cleats are on the opposite side and remaining 4 nos cleats are on the opposite side of the post. The cleats on the corner posts shall be welded in such a way that it suits the site requirement.

The whole assembly of tubular post shall be hot dip galvanised. The zinc coating shall be minimum 615 gram per sq mm. The purity of the zinc shall be 99.95% as per IS:209.

**Fence fabric panel:**

Chain link fencing shall be fabricated in the form of panel 2000X3000 mm. An MS flat of at least 50X6 mm size shall be welded all round fence fabric to form a panel. Four pairs of 13.5 mm diameter holes on the vertical MS flat matching the spacing of holes in cleats fixed with pipe shall be provided to fix the fence panel with tubular posts. A washer shall also be provided below each nut. 12 mm diameter bolts and nuts including washers shall also be supplied. All bolts, nuts and washer shall be hot dip galvanised. The fence panel shall be also of hot dip galvanised.

**Installations:**

Fence shall be installed along switch yard line as per the approved GA drawing.

Post holes shall be excavated by approved method.

All posts shall be 3 mtrs apart measured parallel to ground surface.

Posts shall be set in 1:2:4 plain cement concrete block of minimum 0.4X0.4X1.2mtr depth. 75 mm thick PCC 1:4:8 shall be provided below concrete block.

Fence fabric panel shall be fixed to the post at 4 nos. M.S flat each of 50X6 mm, 75mm long through 2 nos of 12 mm dia bolts on each flat.

Paintings as per decision of the Engineer in charge have to be carried out.

Continuous running earth by using 50 X 6 mm GI flats to be provided for safety purpose.

A 345/380 mm thick (one and a half brick size) toe wall of Brick/Rubble masonry or concrete with notches shall be provided below all fencing and shall be minimum 200 mm above and 500 mm below finished ground level. All exposed surfaces for brick toe wall shall be provided with 15 mm 1:6 cement sand plaster and coated with two coats of water proofing snowcem cement paint. In case if rubble masonry is provided suitable pointing shall be done.

**Gates:**

Gates shall be installed in locations shown on drawings. Next to the main gate, a wicket gate (1.25 m wide, single leaf) shall also be provided.

Bottom of gates shall be set approximately 40 mm above ground surface and necessary guiding mechanism (with roller on the bottom of the gate and fixed guider in the road) shall be fitted to avoid hanging of the main gate.

Flexible cooper bond has to be provided to link earthing of the sub station.

## **11.3 CONTROL ROOM CUM SWITCHGEAR BUILDING**

### **11.3.1 General**

The scope includes the design, engineering and construction of control room building. The size of the building will be 17m X 10m. The tentative layout showing the facilities to be provided is indicated at **E21**. However, the size and layout of the building may be modified if the site condition does allow for it. The modification to be done with the approval of the Engineer in Charge.

### **11.3.2 Dimensions**

Normally the building shall have the following design/construction parameters.

- i. There will be 14 nos of 250mm X 250mm RCC (1:1.5:3) columns at a spacing of 2m each.
- ii. The plinth beam will be 250mm X 250mm
- iii. Roof beam – 250mm X 250mm with 1m depth punching
- iv. Roof thickness -100mm
- v. Flooring – Vitrified tile
- vi. Bath room – Ceramic tile
- vii. Inside wall – Primer putty and plastic emulsive paint
- viii. Outside wall – Primer with weather seal coat.
- ix. Front door – 5'X6'6" Aluminium Door
- x. Inside Door – 4'X6'6" Aluminium
- xi. Windos – 6 nos. Aluminium

An open space of one metre minimum shall be provided on the periphery of the rows of panels, and equipment generally, in order to allow easy operator movement and access as well as maintenance.

The building design shall also take into consideration the layout of the panels, switchboards, switchgear and other equipment in order to allow enough area for the future extension of switchyard depending upon the availability of subEngineer in Charge area.

The building auxiliary services such as air conditioning and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant sections of this Specifications to allow for easy access to equipment and maintenance of the equipment

The doors and windows of the building shall be of aluminium extruded channels, angles etc. The windows shall be provided with sliding shuttering facilities and also to be provided with aluminium make grills.

### **11.3.2 Dimensions**

An open space of one metre minimum shall be provided on the periphery of the rows of panels, and equipment generally, in order to allow easy operator movement and access as well as maintenance.

The building design shall also take into consideration the layout of the panels, switchboards, switchgear and other equipment in order to allow enough area for the future extension of switchyard depending upon the availability of substation area.

The building auxiliary services such as air conditioning and ventilation systems, fire protection and detection systems and all other miscellaneous services shall be designed in accordance with the requirements specified in relevant sections of this Specifications to allow for easy access to equipment and maintenance of the equipment

The doors and windows of the building shall be of aluminium extruded channels, angles etc. The windows shall be provided with sliding shuttering facilities and also to be provided with aluminium make grills.

In Urban area of traditional 33/11 Kv S/S the Control Room area is 15x8 Mts.

In rural area of traditional 33/11 Kv S/S the Control Room area is 10x8 Mts.

### **11.3.4 Submission of data for approval**

The following information shall be submitted for review and approval to the Engg In-charge :

- Design criteria for structural steel and reinforced concrete design. The criteria shall comprise the codes and standards used, applicable climatic data including wind loads, earthquake factors and maximum and minimum temperatures applicable to the building locations, assumptions of dead and live loads, including equipment loads, impact factors, safety factors and other relevant information.
- Structural design calculations and drawings including those for construction and fabrication for all reinforced concrete and structural steel structures.
- Fully dimensioned floor plans, cross sections, longitudinal sections and elevations of each building. These drawings shall be drawn at a scale not less than 1:50 and shall identify the major building components.
- Fully dimensioned drawings showing details and sections, drawn to scales of sufficient size to clearly show sizes and configuration of the building components and the relationship between them.



- Product information of building components and materials, including walls, partitions, flooring, ceilings, roofing, doors and windows and building finishes.
  - A detailed schedule of building finishes including colour schemes.
  - A door and window schedule showing door types and locations, door lock sets and latch sets and other door hardware.
  - Anti Termite treatment of Control Room to be done by the contractor.
- Approval of the above information shall be obtained before ordering materials or starting fabrication or construction as applicable.

#### **11.4 Flooring (52 mm Thick)**

50mm thick cement concrete 1:2:4. & finishing with vitrified tiles in the main control room area (Urban Control Room), in other areas plain flooring. There shall be dado of 9 inches by the same materials used in flooring. The toilets and bath rooms shall be provided with antiskid ceramic tiles and the walls are also to be provided with ceramic tiles of adequate height as per standard practice.

#### **11.5 Walls**

Control room buildings shall have framed superstructure. All walls shall be non-load bearing walls (In case of single storied ). In case of double storied it should be RCC column & Beam structure. Minimum thickness of external walls shall be 230 mm with 1:6 cement sand mortar. A 100 mm thick (RCC, M-15 mix) DPC shall be provided at plinth level before starting masonry work.

#### **11.6 Plastering**

All internal walls shall have minimum 12mm thick 1:6 cement sand plaster. The ceiling shall have 6mm thick 1:4 cement sand plaster.

#### **11.7 External Finish**

All external surfaces shall have painted with weather proof synthetic paints over 18mm thick cement sand plaster in two layers. Under layer 12mm thick cement plaster 1:5 (1 cement:5 coarse sand) and a top layer 6mm thick cement plaster 1:3 (1 cement:3 coarse sand) finished rough with sponge.

All ceilings shall be white based plastic emulsion paints and the internal walls are also to be provided with plastic emulsion synthetic paints. The outer of the building shall be provided with weather seal coats of synthetic paints.

#### **11.8 Roof**

Roof of the building shall consist of cast in situ R.C.C. slabs (M-20) grade. Extra heavy water proofing treatment of approved standard shall be done after grading under bed with 1:4 cement sand plaster of 25mm thickness. The under bed shall be laid to provide an ultimate run off gradient of 1:120. The

extra heavy treatment shall be concrete based with water proof treatment as per the standard to protect the roof from damage due to water logging. Proper slope and adequate no of water drains outlets shall be provided for easy discharge of water from the roof. These drains shall be connected to the main drain.

### **11.9 Glazing (glass)**

Minimum thickness of glazing shall be 6 mm. The glazing for the control room area, which will be air-conditioned shall be provided with double toughened glass each of 6mm thickness.

### **11.10 Plumbing And Sanitation**

All plumbing and sanitation work shall be executed to comply with the requirements of the appropriate bye laws, rules and regulations of the Local Authority having jurisdiction over such matters. The Contractor shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.

An overhead water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided.

Galvanised MS pipe of medium class conforming to IS : 1239 shall be used for internal piping works for portable water supply.

Sand C I pipes with lead joints conforming to IS:1729 shall be used for sanitary works above ground level.

A list of toilet fittings will be approved by the Engg In-charge , before procurement by the contractor and same will be inspected by the Engg In-charge before installation. Sufficient nos of toilets and bath rooms including separate urinal provision shall be provided at both ground and first floors. Required nos of wash basins (stand type) with good quality mirrors and other accessories as required are also to be provided at both ground and first floor of control room building. Same procedure for colony quarters also.

### **11.11 Building storm water drainage**

The building design shall provide for the collection of storm water from the roofs. This water shall be collected in junction boxes and these boxes shall drain to the main drainage system of the station.

Cast iron rain water down comers conforming to IS: 1230 with water tight lead joints or medium class galvanised mild steel pipes conforming to IS:1239 / IS:3589, shall be provided to drain off the rain water from the roof. These shall be suitably concealed with masonry work of cement concrete or cladding material. The number and size of down comers shall be governed by IS: 1742 and IS: 2527.

All drains inside the buildings shall have minimum 40 mm thick grating covers and in areas subject to movement heavy equipment loads, pre cast RCC covers shall be provided in place of steel grating.

For all buildings, suitable arrangement for draining water collected from equipment blow downs, leakages, floor washings, fire fighting etc. shall be provided for each floor.

#### **Plinth protection Flooring**

Entire area around the control room building (out side) shall be provided with PCC paving starting from the building upto 2 mtrs clear distance for the full length of the building.

The above specified PCC paving shall be with M15 mix grade concrete over suitable under bed arrangement as specified for other ground floor slab.

Above the PCC paving suitable cement pavers chequered plate of size as per the standard to be provided. The colour of the chequered plate shall be fixed over the PCC paving by using cement mortar and the colour of such plate shall be red.

The cable vault below the main control room shall have 50 mm thick smooth floor finish units of cement concrete.

Anti termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS:6313 and other relevant Indian Standards.

### **11.12 WATER SUPPLY**

The Contractor shall be overall responsible for supply of water within switchyard / control room for fire fighting, drinking purposes and other miscellaneous purposes. Water shall be made available at a single point by the Employer. The scope is also inclusive of supply and erection of all over head tanks, pipes, fittings etc. required for the water supply to be taken from the terminal point to the respective required areas. A scheme shall be prepared by the contractor indicating the layout and details of water supply which shall subject to the approval of the Engg In-charge before actual start of work. Any extra bore holes required shall be within the scope of the contractor. There shall be pump houses for the bore wells and approach road to the pump houses shall be provided.

The Contractor shall have overall responsibility to provide a suitable arrangement for permanent supply for and retention of water within switchyard building and to the yard for watering to the earth pits, drinking purposes. The submersible pump shall be 1 HP and all control as per standard has to be provided.

## 12.0 EARTHING :

Earth Grid should not be more than TWO meters square. This should be done by using 75x10 mm GI flats. Earth risers should be 50x6 mm GI flats. All equipments & metal parts of the Sub-Station should be connected with main earth grid by using 50x6 GI flats at two different places. The main earth grid should be laid not less than 600 mm below the finished ground level. The lap welding should not less than 100 mm. The welding of joints should be done after removal of Zinc by using Blow lamps. Welding should be done in all four sides and should be double layer continuous. Before taking up the second layer welding the deposited flux should be removed. During welding the two flats should be tightened properly by using ' C ' clamps. Immediately after welding two layers of anti-corrosive paints should be painted over the welded portion along with two coats of Black bituminous paints. Before back filling of earth trenches the welded portion should be covered by wrapping with bituminous tape properly and also jointing portion should be covered with PCC (1:2:4) mix. The backfilling of earth pits and trenches should be done with powered loam soil mixed with Bentonate powder (10:1) mix.

All equipments, steel structures etc should be connected with Main earth mat at two rows separately. All LAs, PTs , Columns having spikes should individually connected with individual Pipe electrodes and again should be connected with main earth grid at two separate places. The Neutral of Power Transformer should be connected with two separate pipe electrodes and again connected with main earth electrodes at two separate places. The separation distance between each pipe electrodes should not be less than 2 mts. The back filling of pipe electrodes should be done in layer of Charcoal, Salt & loam soil mixed with Bentonate power.

There should be a closely spaced earth grid ( 1.5 mts square having .5 mts spacing) below the mechanism boxes of each Isolators & AB switches. In Sub-station the diameter of pipe electrode should not be less than 50 mm. The Flange( 50x6) mm GI flat should be welded in all sides with Pipe electrode. In each face of Flange there should be two nos 17.5 mm hole to accommodate 16 mm GI Bolt nut with 1 no spring washer.

The fencing of sub-station should not directly connected with main earth grid. There should be a separate earth grid ( 75x10) mm GI flat 2 mts away from fence and should be connected rigidly with the fence at an interval of 5 mts. There should be one 50x6 mm earth flat run over the cable rack and should be connected with main earth grid at an interval of 5 mts The jointing portion of

earth flats over the ground should be painted with two coats of Anti-corrosive paints and two coats of good quality of Aluminium paints (Berger/Asian paints).

The water hydrant system should be provided in the areas where earth resistivity more and soil is laterite and sandy in nature (Areas like BBSR, Khurda , Puri etc) as per the direction of Engineer in charge. Each handles of Isolators/AB switches etc should be connected with earth grid by using flexible Tinned Copper earth bonds. In each earth switches TWO nos flexible earth bonds should be provided. Each earth pits having pipe electrodes should be provided 250 mm Brick wall chambers with RCC cover Slab.

#### **12.01 (A) G.I. Flat (75x 10 mm) & G.I.Flat (50 x 6 mm)**

The specification covers manufacture, testing and supply of Galvanized Steel flat for Earthing arrangements.

#### **I. APPLICABLE STANDARDS:**

Materials shall conform to the latest applicable Indian standards. In case bidders offer steel section and supports conforming to any other international specifications which shall be equivalent or better than IS, the same is also acceptable.

<b>SI. No.</b>	<b>Standard No.</b>	<b>Title</b>
1	IS:2062 Grade 'A' Quality	Specification for M.S. Channel and
M.S. Flat		
2	IS:2062	Chemical and Physical Composition of material
3	IS:1852	Rolling and Cutting Tolerances for Hot Rolled Steel products

#### **II. RAW MATERIAL :**

The steel section shall be re-rolled from the BILLETS/INGOTS of tested quality as per latest version of IS: 2830 or to any equivalent International

standard and shall be arranged by the bidder from their own sources. The chemical composition and physical properties of the finished materials shall be as per the relevant standards.

### III. TEST

Steel sections shall be tested in IS approved laboratory or standard laboratory of the Bidder country having all facilities available for conducting all the tests as prescribed in relevant IS or IEC or to any equivalent International laboratory or Institutions.

The Bidders are required to specifically indicate that;

They hold valid IS (or equivalent IEC) License. Steel Section offered are bearing requisite IS certification or equivalent IEC marks.

The Bidders are required to submit a copy of the valid IS (or equivalent IEC) License clearly indicating size and range of product against respective ISS or any equivalent International Standards along with their offer.

### IV. PHYSICAL & CHEMICAL PROPERTIES

#### Length

The GS Flat to be supplied shall be in 5.5 meters to 13 meters lengths.

#### Weighment

The weighment of GS Flat shall be witnessed by the consignee at the time of taking delivery. The weight recorded in the material receipt certificate issued by the consignees shall be final.

Chemical composition and physical properties of M.S.Channels and M.S.Flat conforming to IS: 2062/84L composition.

<b>Chemical Composition</b>		<b>For Fe 410 WA Grade</b>
1	C -	0.23% MAX.
2	Mn -	1.5% MAX.

3	S -	0.050% MAX.
4	P -	0.050% MAX.
5	SI -	0.40% MAX.
6	CE -	0.42% MAX.

(Carbon Equivalent)

## V. Mechanical Properties

1.	Tensile strength Kgf/mm <sup>2</sup>	- 410
2.	Yield stress Min. for thickness/diameter	
	<20 mm	- 26 Kgf/mm <sup>2</sup> OR
250N/mm <sup>2</sup>	20-40 mm	- 24Kgf/mm <sup>2</sup> OR
240N/mm <sup>2</sup>	40 mm	- 23Kgf/mm <sup>2</sup> OR
230N/mm <sup>2</sup>		
3.	Elongation %	- 23%
4.	Bend Test (Internal Dia)	- Min-3t (this the
thickness of the		material)

## VI. MARKING

It is desirable that the Bidders should put his identification marks on the finished materials. The mark shall be in "legible English letters"

## VII. INSPECTION AND TEST CERTIFICATE

The materials to be supplied will be subject to inspection and approval by the purchaser's representative before dispatch and / or on arrival at the destination. Inspection before dispatch shall not, however, relieve the bidders of his responsibility to supply the steel section strictly in accordance with the specification.

The bidders shall abide by all the statutory provisions, acts such as the Indian Electricity Act, Indian factory Act, Indian Boiler Act etc., and corresponding rules and regulations as may be applicable and as amended from time to time.

The purchaser's representative shall be entitled at all reasonable time during manufacture to inspect, examine and test at the bidder's premises the materials and workmanship of the steel section to be supplied. As soon as the

steel section are ready for testing , the bidder's shall intimate the purchaser well in advance, so that action may be taken for getting the material inspected. The material shall not be dispatched unless waiver of inspection is obtained or inspected by the purchaser's authorized representative. The test certificate shall be in accordance with the latest version of the relevant Indian Standard or any equivalent International standards.

The acceptance of any batch /lot shall in no way relieve the bidder of any of his responsibilities for meeting all the requirements of the specification and shall not prevent subsequent rejection of any item if the same later found defective.

All conductors buried in earth and concrete and above ground level shall be galvanized steel. Galvanized steel shall be subject to four one minute dips in copper sulphate solution as per IS:2633/1922.

#### **VIII. METHOD OF GALVANISING:**

<b>Sl. No.</b>	<b>Tests</b>	<b>For GI Flat</b>
1	Dip test	6 dips of 1 min each
2	Mass of Zinc coating	610 gram/sq.m minimum

Pre dispatch inspection shall be performed to witness following tests:

Freedom from defects,  
Verification of dimensions  
Galvanization tests  
Mechanical tests  
Chemical composition tests

These tests are to be performed and certified at Govt. recognized laboratory.

MS flat shall conform to IS 2062 & its latest amendments for steel & Galvanization as per IS 4759 & its Latest amendments.

The flat shall be coated with Zn 98 Zinc grade.

The minimum Zinc coating shall be 610 gm/sqm for thickness more than 5 mm and 460 gm/sqm for item thickness less than 5 mm.

#### **IX. Inspection & Rejection :**



The representative of Purchaser shall pick up samples at random from the GI Flats offered for carrying out routine tests as per specified IS.

The representative shall make visual inspection on each & every GI flats.

The purchaser reserves the right to reject on inspection after the same is received at destination.

### **12.1 (B) G.I. Flat (75 x 10 mm) & G.I. Flat (50x 6 mm)**

(To be submitted along with Offer)

<b>Sl. No</b>	<b>Particulars</b>	<b>Bidders' Offer</b>
1	Location of Factory or Place of Manufacture	
2	Maker's Name, Address & Country	
3	Size of G.I. Flat	
4	Standard Length	
5	Galvanization Process	
6	Galvanization thickness	
7	Galavanization tests to be conducted	

### **12.1 (C) Earth Electrode (50/40 NB 3.0 Mtr Length)**

#### **I. Qualification Criteria of sub vendor / Manufacturer:-**

The prospective bidder may source Earth Electrode from sub vendors / manufacturers who must qualify all the following requirements :

a) The sub vendor /manufacturer must have successfully carried out Type Test of similar item from any NABL Accredited Laboratory within the last 5 years, prior to the date of submission of the bid.

b) The manufacturer should have supplied at least 200 no.s to electricity supply utilities / PSUs. The bidder should enclose Performance Certificates from the above users issued in the name of the manufacturer / sub vendor as proof of successful operation in field.

#### **II. Scope :-**

This specification provides for design, manufacturing, testing before dispatch, supply & delivery of Earthing Device (Heavy Duty) (for use in line (40x3000) mm & SS(50x3000 mm), as per enclosed Drawing.

### **III. APPLICABLE STANDARDS :-**

The Earthing Device must be made out of 50 mm for S/S, 40 mm for line (Heavy Gauge- No minus Tolerance allowed) Wall thickness Hot Dip G.I. Pipe (as per IS :- 1239, Part-1, 1990 of reputed Make(TATA/Jindal) & 3.0 mtrs length tapered finished smooth at one end for a length of 75 mm & Clamp at the other end.

Staggered drills hole of 12 mm Dia of interval of 150mm shall be made before galvanization.

The GI Earthing Clamp/ Strip (C- Clamp Type) is to be of 50mm width, 6mm thickness & flange length of 65 mm in each side. This should be suitable for termination of 4 nos of GI Flat earth electrodes. The Clamp/ Strip & Earthing pipe after fabrication will be hot dip galvanized confirming to IS: 2629/85 with latest amendments. The clamp shall have two holes in both sides suitable for 16 mm GI Bolts & Nuts.

### **IV. GALVANISING**

For use in construction at coastal areas as well as other areas it shall be required for galvanizing the Cross arms and Pole top brackets as following :

All galvanizing shall be carried out by the hot dip process, in accordance with Specification IS 2629. However, high tensile steel nuts, bolts and spring washer shall be electro galvanized to Service Condition 4. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spot and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the galvanic bath which could have a detrimental effect on the durability of the zinc coating.

Before picking, all welding, drilling, cutting, grinding and other finishing operations must be completed and all grease, paints, varnish, oil, welding slag

and other foreign matter completely removed. All protuberances which would affect the life of galvanizing shall also be removed.

**The weight of zinc deposited shall be in accordance with that stated in Standard IS 2629 and shall not less than 0.61kg/m<sup>2</sup> with a minimum thickness of 86 microns for items of thickness more than 5mm, 0.46kg/m<sup>2</sup> (64 microns) for items of thickness between 2mm and 5mm and 0.33kg/m<sup>2</sup> (47 microns) for items less than 2mm thick.**

Parts shall not be galvanized if their shapes are such that the pickling solutions cannot be removed with certainty or if galvanizing would be unsatisfactory or if their mechanical strength would be reduced. Surfaces in contact with oil shall not be galvanized unless they are subsequently coated with an oil resistant varnish or paint.

In the event of damage to the galvanizing the method used for repair shall be subject to the approval of the Engineer in Charge or that of his representative. Repair of galvanizing on site will generally not be permitted.

The threads of all galvanized bolts and screwed rods shall be cleared of spelter by spinning or brushing. A die shall not be used for cleaning the threads unless specifically approved by the Project Manager. All nuts shall be galvanized. The threads of nuts shall be cleaned with a tap and the threads oiled.

Partial immersion of the work shall not be permitted and the galvanizing tank must therefore be sufficiently large to permit galvanizing to be carried out by one immersion.

After galvanizing no drilling or welding shall be performed on the galvanized parts of the equipment excepting that nuts may be threaded after galvanizing. To avoid the formation of white rust galvanized materials shall be stacked during transport and stored in such a manner as to permit adequate ventilation. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

The galvanized steel shall be subjected to test as per IS-2633.

The galvanization tests are to be conducted as per IS: 2633/72 & IS: 6745/72 & its latest amendments.

### 12.1. (D) Earth Electrode (50 NB 3.0 Mtr Length)

#### Guaranteed Technical Particulars

(To be submitted along with Offer)

Sl. No.	Particulars	Bidder's Offer
1	Location of Factory or Place of Manufacture	
2	Maker's Name, Address & Country	
3	Size of	
	a) Pipe	
	b) Earthing Strips	
4	Length	
5	Thickness of Pipe	
6	Galvanization Process	
7	Galvanization thickness	
	a) For Earthing device	
	b) For Connecting Flat	
8	Galvanization tests to be conducted as per ISS	
9	Any other Particulars ( like details of Clamp/ G.I. Bolts)	
10	Details of Drawings submitted	

Metal parts of all equipment other than those forming part of an electrical circuit shall be connected directly to the main earth system via two separate conductors of adequate capacity at two different points.

All main members of structural steelworks shall be earthed by galvanised iron flat connections bonded by welding or bolting to the steelworks.

Connections to apparatus and structures shall be made clear of ground level, preferably to a vertical face and protected as appropriate against electrolytic corrosion. They shall be made between clean surfaces and of sufficient size and pressure to carry the rated short circuit current without damage.

Earth bars installed directly into the ground should normally be laid bare and the trench back-filled with a fine top soil. Where the soil is of a hostile nature,

special precautions must be taken to protect the earth bar. Wherever required to achieve the required resistance bentonite powder to be mixed in lom/ black cotton crushed soil in 1: 6 proportion is permissible, the method used being subject to the agreement of the Engg. Incharge . In the event of bentonite powder being adopted, water supply through conduit to the area must be supplemented and regulated to keep the surface / mat moisture absorbent.

Joints in earth bars+ shall be welded and then coated with a suitable anti-corrosion protection treatment.

Facilities shall be provided on the earth bar run between equipment and the base of structures, comprising a looped strip, so as to permit the attachment of portable earth connections for maintenance purposes.

The cross sectional area of the earth bar and connections shall be such that the current density is not greater than  $100 \text{ A/mm}^2$  for a 3 second fault duration.

### **13.0 Welding and welders qualifications**

#### **13.1 General**

All welding shall be carried out by qualified welders only.

All welding shall be in accordance with the corresponding standards of the American Welding Society or the American Society of Mechanical Engineers.

Other standards to determine the quality of welding process and qualifications of welders may be considered, provided that sufficient information is first submitted for the approval of the Engg. Incharge .

Prior to the start of fabrication, the Contractor shall submit to the Engg. Incharge for approval, a description of each of the welding procedures which he proposes to adopt, together with certified copies of reports of the results from tests made in accordance with these procedures.

The Contractor shall be responsible for the quality of the work performed by his welding organisation. All welding operators, to be assigned work, including repair of casting, shall pass the required tests for qualification of welding procedures and operators. The Engg. Incharge reserves the right to witness the qualification tests for welding procedures and operators and the mechanical tests at the samples.

The Contractor shall bear all his own expenses in connection with the qualification tests. If the work of any operator at any time appears questionable, such operator will be required to pass appropriate pre-

qualification tests as specified by the Inspector and at the expense of the Contractor.

Welding carried out in ambient temperature of 5C or below shall be heat treated.

A spacer wire of proper diameter may be used for weld root opening but must be removed after tack welding and before applying root run.

On completion of each run craters, weld irregularities, slag etc. shall be removed by grinding or chipping.

During the process of welding, all movements, shocks, vibration or stresses shall be carefully avoided in order to prevent weld cracks.

Fillet welds shall be made by shielded metal arc process regardless of thickness and class of piping. Electrode size shall not exceed 10 SWG. (3.25 mm). At least two runs shall be made on socket weld joints.

## **14.0 WIRING, CABLING AND CABLE INSTALLATION**

### **14.1 Cubicle wiring**

Panels shall be complete with interconnecting wiring between all electrical devices in the panels. External connections shall be achieved through terminal blocks. Where panels are required to be located adjacent to each other all inter panel wiring and connections between the panels shall be carried out internally. The Contractor shall furnish a detailed drawing of such inter panel wiring. The Contractor shall ensure the completeness and correctness of the internal wiring and the proper functioning of the connected equipment.

All wiring shall be carried out with **1.1 kV** grade, **PVC** insulated, single core, stranded copper wires. The PVC shall have oxygen index not less than '**29**' and Temperature index not less than **250C**. The wires shall have annealed copper conductors of adequate size comprise not less than three strands.

The minimum cross sectional area of the stranded copper conductor used for internal wiring shall be as follows :

- a) All circuits excepting CT circuits and energy metering circuit of VT 2.5 sq.mm
- b) All CT circuits and metering circuit of VT 2.5 sq. mm

All internal wiring shall be supported, neatly arranged, readily accessible and connected to equipment terminals and terminal blocks. Wiring gutters and troughs shall be used for this purpose.

Cubicle connections shall be insulated with PVC to IEC 227. Wires shall not be jointed or teed between terminal points.

Bus wires shall be fully insulated and run separately from one another. Auxiliary bus wiring for AC and DC supplies, voltage transformer circuits, annunciation circuits and other common services shall be provided near the top of the panels running throughout the entire length of the panel suite. Longitudinal troughs extending throughout the full length of panel shall be preferred for inter panel wiring.

All inter connecting wires between adjacent panels shall be brought to a separate set of terminal blocks located near the slots of holes meant for the passage of the interconnecting wires. Interconnection of adjacent panels on site shall be straightforward and simple. The bus wires for this purposes shall be bunched properly inside each panel.

Wire termination shall be made with solderless crimping type and tinned copper lugs which firmly grip the conductor. Insulated sleeves shall be provided at all the wire terminations. Engraved core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wire and shall not fall off when the wire is disconnected from terminal blocks. Numbers 6 and 9 shall not be included for ferrules purposes unless the ferrules have numbers underscored to enable differentiation. (i.e. 6 and 9 ).

Fuses and links shall be provided to enable all circuits in a cubicle, except a lighting circuit, to be isolated from the bus wires.

The DC trip and AC voltage supplies and wiring to main protective gear shall be segregated from those for back-up protection and also from protective apparatus for special purposes. Each such group shall be fed through separate fuses from the bus wires. There shall not be more than one set of supplies to the apparatus comprising each group. All wires associated with the tripping circuits shall be provided with red ferrules marked "**Trip**".

It shall be possible to work on small wiring for maintenance or test purposes without making a switchboard dead.

The insulation material shall be suitably coloured in order to distinguish between the relevant phases of the circuit.

When connections rated at 380 volt and above are taken through junction boxes they shall be adequately screened and "**DANGER**" notices shall be affixed to the outsides of junction boxes or marshalling kiosk.

Where connections to other equipment and supervisory equipment are required the connections shall be grouped together.

#### **14.2 LV power cabling**

**LVAC** cable terminals shall be provided with adequately sized, hot pressed, cast or crimp type lugs. Where sweating sockets are provided they shall be without additional clamping or pinch bolts. Where crimp type lugs are provided they shall be applied with the correct tool and the crimping tool shall be checked regularly for correct calibration. Bi-metallic joints between the terminals and lugs shall be provided where necessary.

Terminals shall be marked with the phase colour in a clear and permanent manner.

A removable gland plate shall be provided by the Contractor. The Contractor shall be responsible for drilling the cable gland plate.

Armoured cables shall be provided with suitable glands for terminating the cable armour and shall be provided with an earthing ring and lug to facilitate connection of the gland to the earth bar.

#### **14.3 Multi-core cables and conduit wiring**

External multi-core cabling between items of main and ancillary equipment shall form part of the Contract Works and shall consist of un-armoured multi-core cable with stranded copper conductors PVC insulated and PVC over sheathed complying with the requirements of IEC 227 and 228 as applicable.

Multi-core cable for instrumentation and control purposes shall be supplied with 2.5 mm<sup>2</sup> stranded copper cores. Multi-core cables for CT and VT circuits shall be supplied with two by 2.5 mm<sup>2</sup> stranded copper cores and the cores shall be identified by the phase colour.

Where conduit is used the runs shall be laid with suitable falls and the lowest parts of the run shall be external to the equipment. All conduit runs shall be adequately drained and ventilated. Conduits shall not be run at or below ground level.

Multi-core cable tails shall be so bound that each wire may be traced to its cable without difficulty. All multi-core cables shall be provided with 20 % spare cores and the spare cores shall be numbered and terminated at a terminal block in the cubicle. Where cables are terminated in a junction box and the connections to a relay or control cubicle are continued in conduit, the spare



cores shall be taken through the conduit and terminated in the cubicle. The dc trip and ac voltage circuits shall be segregated from each other as shall the circuits to main protective gear be segregated from those for back-up protection.

The screens of screened pairs of multi-core cables shall be earthed at one end of the cable only. The position of the earthing connections shall be shown clearly on the diagram.

All wires on panels and all multi-core cable cores shall be crimped with the correct size of crimp and crimping tool and will have ferrules which bear the same number at both ends. At those points of interconnection between the wiring carried out by separate contractors where a change of number cannot be avoided double ferrules shall be provided on each wire. The change of numbering shall be shown on the appropriate diagram of the equipment. The same ferrule number shall not be used on wires in different circuits on the same panels.

The Contractor shall provide a two (2) metre loop of spare cable at both ends of all multi-core cable runs and shall leave sufficient lengths of tails at each end of the multi-core cables to connect up to the terminal boards. The Contractor shall also strip, insulate, ring through and tag the tails and shall also seal the cable boxes. The Contractor shall be responsible for re-checking the individual cores and for the final connecting up and fitting of numbered ferrules within all equipment provided on this contract.

The drilling of gland plates, supply and fitting of compression glands and connecting up of power cables included in the Contract scope of work shall be carried out under this contract.

## **15.0 Laying and installing of cables**

### **15.1 General**

For cable laying the following shall apply:

- a) Switchyard area                      In concrete cable troughs (cable trench having cable racks with cable trays)
- b) Control Room                      On cable racks consisting of slotted type and ladder type cable trays
- c) Buildings                      Conduits

Directly buried cables shall be used wherever necessary with the approval of Engg. Incharge .

### **15.2 Laying of cable**

Cables shall be laid in concrete troughs provided under this contract or drawn into pipes or ducts or on cable racks or directly buried as may be required by the Engg. Incharge . Concrete troughs shall be designed so that the cables are supported on cable support systems and the supports shall be arranged so as to allow the segregation of power, control (including CT and VT circuits) and communications cables onto different layers of cable supports. All cable supports shall be earthed in accordance with IS 3043. The minimum vertical separation between layers of cable tray shall be not less than 300 mm.

The cable support system shall be designed and constructed to carry the required cables without undue crowding of the supports and without overloading the supports. The maximum number of layers of cable that shall be permitted on a single cable support shall be three. The width of the cable supports shall be selected to ensure that the supports are not crowded, the cable supports are not overloaded and that sufficient space is provided in the cable trough to allow for personnel access during and after cable installation. The width of cable supports should not exceed 750 mm.

Cables shall be laid direct in the ground only at the discretion of the Engg. Incharge . All cables laid direct in the ground outside buildings shall be laid in a trench and protected by reinforced concrete slabs or cable tiles.

For auxiliary cables the top of the slab or tile shall be at a depth not less than 300 mm below the surface of the ground and there shall be a layer of fine well packed riddled earth 75 mm thick in between the cable and the bottom of the trench and between the top of the cable and the underside of the slab.

The Contractor shall be responsible for the proper laying of all cables in the ground. Where cables in the same trench are laid over each other, they shall be separated by not less than 75 mm of riddled earth. The riddled earth used for this purpose shall have been passed through a screen having a 12 mm square mesh.

Where cables pass under roadways they shall be laid in pipes at a depth not less than 800 mm below the surface.

The Contractor shall be responsible for the excavation of trenches which shall include all pumping and baling required and the provision of all necessary labour, plant, tools, water, additional soil, fuel or motor power for such purposes.

Cables in trenches will be inspected by the Engg. Incharge before the trenches are backfilled.

The running of communications and power cables along the same route shall be avoided as far as possible. Where this is not possible they shall be segregated, the one group from the other. Power and communication cables shall be laid in separate tiers. For other than directly buried cables the order of laying of various cables shall be as follows:

- a) Power cables on top tiers.
- b) Control/ instrumentation and other service cables in bottom tiers.

### **15.3 Cable tags and markers**

Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

The tag shall be of aluminum with the number punched on it and securely attached to the cable conduit by not less than two turns of 20 SWG GI wire conforming to IS 280. Cable tags shall be of rectangular shape for power cables and of circular shape for control cables.

Location of cables laid directly in the ground shall be clearly indicated with cable marker made of galvanised iron plate.

Location of buried cable joints shall be indicated with a cable marker having an additional inscription "**Cable joint**".

Cable markers shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct, conduit entry and at every twenty meters (20 m) in cable tray/trench runs. Cable tags shall be provided inside switchgear, motor control centres, control and relay panels etc. and wherever required for cable identification when a number of cables enter together through a gland plate.

The price of cable tags and markers shall be included in the installation rates for cables/conduits quoted by the Bidder.

### **15.4 Cable supports and cable tray mounting arrangements in control room**

The control room will normally be provided with embedded steel inserts on concrete floors/walls for the purpose of cabling in the control room. The supports shall be secured by welding to these inserts or available building steel structures. However, in cases where no such embedded steel inserts are

available, the same shall have to secure to the supports on walls or floors by suitable anchoring.

### **15.5 Cable support structure in switchyard cable trenches**

The contractor shall fabricate and install cable support structures in cable trenches. These supports shall be provided at 750 mm spacing along the run of cable trenches.

Cable supports and cable racks shall be fabricated from standard structural steel members, channels, angles and flats of required size. The fabrication, welding and erection of these structures shall conform to the relevant clauses of this Specification, in addition to the specification given herein.

### **15.6 Termination of cables and wires**

Where cables leave the apparatus in an upward direction the cable boxes shall be provided with a barrier joint to prevent leakage of cable oil or compound into the apparatus. Where cable cores are liable to contact with oil or oil vapour the insulation shall be unaffected by oil.

PVC sheathed cables shall be terminated by compression glands complying with BS 6121 (or equivalent).

Auxiliary PVC insulated cables shall be terminated with compression type glands, clamps or armour clamps complete with all the necessary fittings.

Colours shall be marked on the cable box, cable tail ends and single core cables at all connecting points and/or any positions the Engg. Incharge may determine. Cable boxes shall be provided with suitable labels indicating the purpose of the supply where such supply is not obvious or where the Engg. Incharge may determine.

All cables shall be identified and shall have phase colours marked at their termination.

All incoming and outgoing connections shall be terminated at a terminal block. Direct termination into auxiliary switches will not be accepted.

### **16.0 SUPPLY VOLTAGE**

The auxiliary supply voltages on site shall be as follows:

<b>Nominal Voltage V</b>	<b>Variation</b>	<b>Frequency Hz or DC</b>	<b>Phase</b>	<b>Wires</b>	<b>Neutral Connection</b>
--------------------------	------------------	---------------------------	--------------	--------------	---------------------------

430	±10%	50±5%	3	4	Solidly earthed
230	±10%	50±5%	1	2	Solidly earthed
24		DC	DC	2	

## **17.0 ERECTION CONDITIONS**

### **17.1 General**

The following shall supplement the conditions already contained in the other parts of these specifications and documents and shall govern that portion of the work on this Contract to be performed at Site.

### **17.2 Regulation of local authorities and statutes**

The Contractor shall comply with all the rules and regulations of local authorities during the performance of his field activities. He shall also comply with the Minimum Wages Act, 1948 and the payment of Wages Act (both of the Government of India and Govt of Orissa ) and the rules made there under in respect of any employee or workman employed or engaged by him or his Sub-Contractor.

All registration and statutory inspection fees, if any, in respect of his work pursuant to this Contract shall be to the account of the Contractor. However, any registration, statutory inspection fees lawfully payable under the provisions of the statutory laws and its amendments from time to time during erection in respect of the substation ultimately to be owned by the Employer, shall be to the account of the Employer. Should any such inspection or registration need to be re-arranged due to the fault of the Contractor or his Sub-Contractor, the additional fees to such inspection and/or registration shall be borne by the Contractor.

The Contractor shall ensure that he obtains, from the Government of Orissa, an Electrical Contractor's Licence and a supervisory certificate of the appropriate grade to allow him to execute the electrical works included in the Contract. The Contractor shall ensure that all workmen possess Workman Permits, issued by the Government of Orissa, for engagement in the Contract Works.

### **17.3 Inspection, testing and inspection certificates**

The provisions of the General Conditions of Contract shall also be applicable to the erection portion of the Works. The Engineer In-charge shall have the right to re-inspect any equipment though previously inspected approved by him at the Contractor's works, before and after the same are erected at Site.

## **18.0 Contractor's field operation**

### **18.1 General**

The Contractor shall inform the Engg. Incharge in advance of field activity plans and schedules for carrying-out each part of the works. Any review of such plans or schedules or methods of work by the Engg. Incharge shall not relieve the Contractor of any of his responsibilities towards the field activities. Such reviews shall not be considered as an assumption of any risk or liability by the Employer or any of his representatives, and no claim of the Contractor will be entertained because of the failure or inefficiency of any such plan or schedule or method of work reviewed. The Contractor shall be solely responsible for the safety, adequacy and efficiency of plant and equipment and his erection methods.

### **18.2 Facilities to be provided by the contractor**

### **18.3 Unloading**

Contractor shall make his own arrangement for unloading the equipment at site.

### **18.4 Tools, tackle and scaffoldings**

The Contractor shall provide all the construction equipment tools, tackle and scaffoldings required for offloading, storage, pre-assembly, erection, testing and commissioning of the equipment covered under the Contract. He shall submit a list of all such materials to the Engg. Incharge before the commencement of pre-assembly at Site. These tools and tackles shall not be removed from the Site without the written permission of the Engg. Incharge .

The Contractor shall maintain an accurate and exhaustive record detailing all equipment received by him for the purpose of erection and keep such record open for the inspection of the Engg. Incharge .

All equipment shall be handled carefully to prevent any damage or loss. All equipment stored shall be properly protected to prevent damage. Equipment from the store shall be moved to the actual location at an appropriate time so as to avoid damage of such equipment at Site.

All the materials stored in the open or dusty location shall be covered with suitable weather-proof and flameproof covering material.

The Contractor shall be responsible for making suitable indoor facilities for the storage of all equipment which requires to be kept indoors.

## **19.0 SITE CLEARANCE**

### **19.1 Clearing and uprooting of tree**

The work shall also consist of numbering of trees, removing and disposing of all materials such as trees, bushes, woods, shrubs, grass, stumps, rubbish, rank vegetation, roots, foreign materials, etc., which in the opinion of the Engg In-charge are unsuitable for incorporation in the works, from within the limits and such other areas as may be specified on the drawings or directed by the Engg In-charge . Clearing and uprooting of tree shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications and taking prior permission from forest department. During clearing and grubbing, the contractor shall take all adequate precautions against soil erosion, water pollution etc., and where required undertake additional works to that effect.

#### **Provision of plantation and developing a garden inside the sub-station.**

At least, 100 nos. flowers bearing plants as per the advice of CESU to be planted along the road side and in and around the control room building after making surface treatment. Provision of water taps facilities at different locations for watering the plants and as well as to the peripheral earth pits.

### **19.2 Programme**

The Contractor shall construct the works in compliance with the outline programme appended to the Bidding Document, and shall submit for the approval of the Engg In-charge a detailed programme in accordance with the requirements of this Specification.

### **19.3 Inclement weather**

As per relevant Code, during hot weather, precautions shall be taken to avoid premature stiffening of the fresh concrete mix and to reduce water absorption and evaporation losses. During hot weather (atmospheric temperature above 40 degree C) or cold weather (atmospheric temperature at or below 5deg.C) concreting shall be done as per the procedure set out in IS 7861.

### **19.4 STANDARDS**

All Civil works shall be carried out as per applicable Indian Laws, latest revision of International Standards and Codes. All materials shall be of best quality confirming to relevant Indian Standards and Codes.

Civil works shall be designed to the required service conditions and /or loads as specified elsewhere in this Specification or implied as per National and International Standards.

## **20.0 MATERIALS AND WORKMANSHIP**

### **20.1 General**

All materials used in the works shall be new and of the best quality of their respective kinds. They shall comply with the requirements of the latest edition of any relevant Indian Standard or Code of Practice where such exist, and current at the date of tendering.

All workmanship shall be of the highest standard, and shall be executed by competent men skilled in their respective trades.

### **20.2 Samples**

In addition to the special provisions made in this specification for sampling and testing of materials by particular methods, samples of any materials and workmanship proposed to be used in the Works may be called for at any time during the Contract by the Engg In-charge and shall be furnished by the Contractor without delay and at the expense of the Contractor. Samples when approved, shall be regarded as the acceptable standard, and any material or workmanship subsequently not complying with that standard shall be rejected and replaced by those of acceptable standard at the expense of the Contractor. Sample storage boxes shall be provided by the Contractor free of cost if requested by the Engg In-charge .

### **20.3 Tests**

Whenever considered desirable by the Engg In-charge , Inspectors may be sent to manufacturer's or subcontractors' premises to test materials or supervise their manufacture.

Where specified or requested the Contractor shall obtain from the manufacturer and send to the Engg In-charge certificates of test, proof sheets, mill sheets, etc., showing that materials have been tested in accordance with this Specification or the relevant Indian Standard.

Notwithstanding any tests which may be directed to be carried out at a manufacturer's and/or subcontractor's works, the Engg In-charge may carry out any tests or further tests he considers necessary or desirable after delivery of materials to the Site.

The Contractor shall provide all labour, equipment and facilities necessary for carrying out the tests both in works and on site.

The cost of routine tests required by IS and this Specification shall be borne by the Contractor. The cost of other tests shall be borne in accordance with the Conditions of Contract.

### **20.4 Names of suppliers and copies of orders**

If so required, and before ordering material of any description, the Contractor shall submit for approval the names of makers or suppliers proposed. Copies



of orders shall also be submitted if so required. The Engg In-charge may at any time withdraw his previously given approval to obtaining materials from any maker or supplier should such maker or supplier fail to supply materials of the specified quality or quantity in the requisite time.

## **20.5 Rejection of materials and workmanship**

The Engg In-charge shall at any time have power to reject materials and workmanship not complying with this Specification or with the approved Drawings. Materials so rejected shall be immediately removed from site and replaced by materials of an approved standard at the expense of the Contractor. Rejected workmanship shall be broken out and replaced by work of an acceptable standard including the supply of new materials by the Contractor, at the expense of the Contractor, and without delay.

## **21.0 Erection of Distribution Transformers**

### **21.1 General**

As a part of this scheme, there is a provision to install distribution transformers on 11 kV line. The contractor shall transport the transformer along with the distribution board (OSM) from the store, install, test and commission the DT of 63/ 100/ 200 KVA capacity.

**a.** The contractor's scope is to install distribution transformers on DP structures up to 100 KVA and on plinth foundation beyond 100 KVA capacity including all support structures, channels, clamps, nut & bolts etc for DT and all other accessories. On 11 kV side, the accessories would be LA, A.B. Switch & HG fuse as specified while on LT side the contractor shall install LT Distribution Box. The construction of foundation is in the scope of contractor as per the approved drawings. Any other item, not specifically mentioned but necessary for safe operation of the distribution transformer is deemed to be included in the scope of the contractor.

**b.** The mounting of LTDB shall be same as that for DT and provision shall be kept for it. LTDB shall be used to take off LT feeders and service connections as well. Distribution box shall have proper locking arrangement.

**c.** The location for installation of DT shall be specified by the owner.

**d.** In rural areas 9 mtr DP structure using PSC poles should be considered where as 150x150 RS Joist are to be used in place of PSC poles in urban areas.

**e.** All steel structures including nuts bolts, fasteners etc should be hot dip galvanized.

## 21.2 Erection of Distribution Transformers

All distribution transformers shall be installed on 11 kV line DP structures / Plinths. Bimetallic connectors shall be provided on HT side of DT. The connectors shall be as per REC specifications.

The HT side connections shall be made with AAA conductor. LT side connections from transformer bushing to MCCB of LTDB shall be made by providing single core Al. un-armoured XLPE LT cable of suitable size and support. The outgoing from MCCB of LTDB to the overhead line are also to be made by providing single core Al. un-armoured XLPE LT cable of suitable size. In both the cases suitable clamping (made from 50x6mm GI Flats with GI Bolts & nuts) arrangement (3nos. at transformer side & 4 nos. at line side) with cushioning, cable gland and end termination kit at both ends shall be provided. The outgoing cable of LTDB has to be connected to the overhead LT line by providing minimum 2 nos. of 3-bolted (M-12) type PG clamps. Required layers of ampere tape and PVC tape are to be wrapped as per requirement.

In case of AB cables directly emanating from the LTDB to LT lines, suitable clamping arrangement with the pole as mentioned above shall be made. Necessary tension clamps, dead end clamps etc. shall be provided on the pole for holding the AB cable properly so that the load of the cable shall not be transferred to LTBD. The contractor shall provide all such clamps, nuts & bolts at no extra cost to the owner.

The contractor shall provide and install a Sign Board of 1ft x 1 ft size at each DT location. The sign board shall be mounted on the pole with suitable clamps. The board shall be of 1.6 mm (min) thick GI sheet and epoxy painted (minimum paint thickness 75 micron) The lay out & the content to be written on the board shall be decided during detailed engineering. The boards shall be prepared through screen printing or better technology. The cost of providing and installing the board shall be included in the quoted rates for DT erection.

**All materials required for completion of job in all respect beyond owner supply has to be approved by the owner prior to procurement. During procurement, contractor supply items should also be inspected and tested including third party unless otherwise waived out.**

## 21.3 Sub-station Fencing

Goat mesh fencing as per BoQ details of size 4.5x4.75x 1.6 meter for plinth mounted S/s & 4.5x2.5x1.6 meter for DP mounted S/s shall be constructed with provision for a Grill gate of size 1.5x1 meter height.

## 21.4 Earthing of Distribution Sub-stations

Five nos. 50mm dia, 3 mtr. Long, heavy gauge Pipe (Jindal / Tata) earthings shall be provided for the distribution Sub-station complying with relevant IS. Adequate quantity of charcoal and salt shall be used to keep the earth resistance low. Two connections from transformer neutral, two nos. from HV side LAs, one from handle of AB switch, transformer body & DP structure shall be provided to the pipe earths. All the five pits shall be connected to an earth grid with 24mtr. long 50x10mm size GI Flats at a depth of 600mm below the ground level for plinth mounted S/s and for DP mounted the same is of 14 mtr. long. The earth risers should be with 50x6 mm GI Flats requiring 34mtrs in both type of S/s.

**TECHNICAL SPECIFICATION**

**FOR**

**FIRE FIGHTING & FIRE DETECTION SYSTEM**

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OF  
FIRE FIGHTING & FIRE DETECTION SYSTEM

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# **TECHNICAL SPECIFICATION FOR FIRE FIGHTING & FIRE DETECTION SYSTEM**

## **1.0 INTENT OF SPECIFICATION**

This specification is intended to cover the design, manufacture, assembly, testing at manufacturer's works, supply & delivery, properly packed for transport FOR site of Portable wall and trolley mounted Fire extinguisher and fire buckets for substation control room building complete with all materials and accessories for efficient and trouble free operation.

The fire extinguisher shall be procured from a vendor who must have at least three years experience in manufacturing of the sam. The materials shall have been successfully type tested during last five years on the date of bid opening. The Type Test reports shall be submitted along with the bid.

## **2.0 SCOPE OF SUPPLY**

The following equipment shall be furnished with all accessories: -

- a. Wall mounted fire extinguisher
- b. Trolley mounted fire extinguisher
- c. Sand buckets with stand.
- d. All installation hardware.
- e. All relevant drawings, data & instruction manuals.
- f. Mandatory spares.
- g. Fire & smoke detection system for the building.
- h. Any fire suppression system required for GIS shall be in scope of bidder.

## **3.0 CODES AND STANDARDS**

All equipment and material shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards except where modified and/or supplemented by this specification.

Equipment and materials conforming to any other standard, which ensures equal or greater quality, may be accepted. In such case copies of the English version of the standard adopted shall be submitted along with the bid.

In particular, the following standards and specifications are applicable.

Indian Electricity Rules	
Indian electricity act	
IS 2190	Selection, installation & maintenance of first aid, fire extinguisher.
	Tariff Advisory Committee Manual
IS 1646	Code for practice for fire safety of buildings
IS 940	Portable fire extinguisher, Water type - specification
IS 2878	Fire extinguisher CO2 type
IS 2171	Specification for fire extinguisher dry powder.
IS 10204	Specification for fire extinguisher Mechanical foam type.

#### **4.0 PORTABLE AND WHEEL/ TROLLEY MOUNTED FIRE EXTINGUISHERS**

4.1 This specification lays down the requirement regarding fire extinguishers of following types :

##### **Portable fire extinguishers.**

- a) Pressurised water type.
- b) Dry chemical powder type
- c) Carbon Dioxide type

##### **Wheel/ Trolley mounted fire extinguishers.**

- a) Mechanical foam type

4.2 All the extinguishers offered by the Bidder shall be of reputed make and shall be ISI marked.

#### **5.0 Design and Construction**

5.1 All the portable extinguishers shall be of freestanding type and shall be capable of discharging freely and completely in upright position.

5.2 Each extinguisher shall have the instructions for operating the extinguishers on its body itself.

5.3 All extinguishers shall be supplied with initial charge and accessories as required.

5.4 Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns.

5.5 All extinguishers shall be painted with durable enamel paint of fire red colour conforming to relevant Indian Standards.

5.6 Pressurisation of water type fire extinguishers shall either be done by compressed air or by using gas cartridge. The constant air pressure type shall conform to IS:6234 and the gas pressure type shall conform to IS:940. Both these extinguishers shall be ISI marked.

5.7 Dry chemical powder type portable extinguisher shall conform to IS: 2171.

5.8 Carbon Dioxide type portable extinguisher shall conform to IS:2878.

5.9 Wheel/ trolley mounted fire extinguishers of 50 litre capacity Mechanical foam type shall conform to IS:13386

## **6.0 Tests and Inspection**

6.1 A performance demonstration test at site of five (5) percent or one (1) number whichever is higher, of the extinguishers shall be carried out by the Contractor. All consumable and replaceable items require for this test would be supplied by the Contractor without any extra cost to Employer.

6.2 Performance testing of extinguisher shall be in line of applicable Indian Standards. In case where no Indian Standard is applicable for a particular



type of extinguisher, the method of testing shall be mutually discussed and agreed to before placement of order for the extinguishers.

## **7.0 Painting**

Each fire extinguisher shall be painted with durable enamel paint of fire red colour conforming to relevant Indian Standards.

Fire Alarm arrangement to be provided for the control cum switchgear Building.

Following Detection facility should be made available

(1) Smoke Detection Facility

(2) Fire Detection Facility

As the building will be used for keeping the indoor switchgear (GIS/AIS), Relay Panels with Sub-station Automation System, Battery & Battery Charger & other important Equipment. Care must be taken for protection against any hazards due to fire. The system should be designed as per the latest standard adopted for protection against fire for electrical control cum switchgear Building.

Protection such detectors shall be provided considering the location of such equipment (as explained above) & also size of the building.

Contractor to design the same in consultant with the latest fire protection standard & also with the manufacturer of the fire equipment.

The type & size of fire Extinguisher should be decided on the basis of design in line with the latest standard followed.

Bidder to quote on Lumpsum basis.

This specification shall be read and constructed in conjunction with the bid documents and annexure to determine the scope of work..

## 8.0 DESIGN CRITERIA

### 8.1. General

The contractor shall supply the required type and quantities of fire extinguisher and Sand buckets. The quantity shall be as per TAC recommendations.

### 8.2. Location

Fire extinguisher and sand buckets shall be installed in Control room, battery room, switchgear room, ACDB & battery charger room, Cable cellar, Transformer yard, Outdoor switchyard and Capacitor bank.

### 8.3. Distribution

The fire extinguishers in various locations shall be as per the guidelines of TAC-India. The maximum distance between placement of fire extinguishers shall be as per TAC rules.

### 8.4. Tests

All equipment shall be completely assembled wired, adjusted and routine tested at the factory as per relevant standards.

## 9.0 DEVIATIONS

Deviations from this Specification shall be stated in writing with the tender by reference to the Specification clause/GTP/Drawing and a description of the alternative offer. In absence of such a statement, it will be assumed that the bidder complies fully with this specification. No deviation will be acceptable post order.

## 10.0 DATA SHEET FOR OPTICAL SMOKE DETECTOR

I	Manufacturer	OPTCL Approved make
II	Principle of operation	Light scattering by smoke particles.
III	Max. recommended spacing	9 m.
IV	Normal operating temperature	-10°C to 60°C
V	Guaranteed to function properly	Yes.
		Accumulated dust to be removed

without any maintenance work  
for periodically by blowing air a  
period of not less than ten (10) years

VI Approval of detector FM of USA, UL of USA, LPCB of U.K. or VDS of  
Germany

VII Cabling. 2C x 1.5 sq.mm.

VIII Cables Un-armoured PVC insulated FR  
conforming to IS 1554 (Part 1).

### 11.0 DATA SHEET FOR HEAT DETECTOR

I	Manufacturer	OPTCL Approved make
II	Principle of operation	Rate of rise-cum-fixed temperature type.
III	Set point of operation	5°C per minute / 55°C
IV	Max. recommended spacing	6 m.
V	Normal operating temperature	-20°C to 70°C
VI	Guaranteed to function properly without	Yes. Accumulated dust to be removed any maintenance work for a period of not less than ten (10) years periodically by blowing air.
VII	Approval of detector	FM of USA, UL of USA, LPCB of U.K. or VDS of Germany
IX	Cabling.	2C x 1.5 sq.mm. Un-armoured PVC insulated FR cables conforming to IS 1554 (Part 1).

## 12.0 DATA SHEET FOR IONISATION SMOKE DETECTOR

I	Manufacturer	OPTCL Approved make
II	Principle of operation	Ionisation of air by Radio-active source.
III	Radio-active source	Americium - 241
IV	Max. recommended spacing	9 m.
V	Normal operating temperature	-10°C to 60°C
VI	Guaranteed to function properly	Yes. Accumulated dust to be removed without any maintenance work for a periodically by blowing air. period of not less than ten (10) years
VII	Approval of detector	FM of USA, UL of USA, LPCB of U.K. or VDS of Germany
VIII	Cabling.	2C x 1.5 sq.mm. Un-armoured PVC insulated FR cables conforming to IS 1554 (Part 1).

## 13.0 DATA SHEET FOR FIRE ALARM SOUNDER (HOOTER)

I	Manufacturer	OPTCL Approved make
II	Construction	Deep drawn sheet steel
III	Type	Dual tone/ Single tone
IV	Operating Voltage	24V DC $\pm$ 10%
V	Output	Not less than 80dB(A) but not more than 120dB(A) at 1.5m distance.

VI	Output frequency range	500Hz. to 1000 Hz.
VII	Operating time	50 minutes (Minimum)
VIII	Material of housing.	M.S. 18 Gauge
IX	Colour	FIRE RED
X	Marking	FIRE ALARM.

**A micro processor based control panel for the fire & smoke detection should be provided in the control room building. Should be designed as per the standard practice adopted for fire & smoke detection. In this regard latest standard for fire fighting to be followed.**

**TECHNICAL SPECIFICATION**

**FOR**

**SUB-STATION & CONTROL ROOM LIGHTING**

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OF  
SUB-STATION & CONTROL ROOM LIGHTING

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**TECHNICAL SPECIFICATION FOR  
SUB-STATION & CONTROL ROOM LIGHTING**

**PART – A**

**1.0 GENERAL**

The scope comprises design, engineering, supply, installation, testing and commissioning of the following:

- a) Complete installation and lighting fixtures complete with lamps, supports and accessories for indoor and outdoor. Street light GI poles etc.
- b) Ceiling fans complete with electronic regulators, accessories;
- c) lighting panels and lighting poles complete with distribution boxes;
- d) Galvanised rigid steel conduits and fittings, lighting PVC cables GI Earth wire receptacles, switchboards, switches, junction boxes, pull out boxes complete with accessories;
- e) Any other items required to complete the indoor and outdoor lighting in complete shape.

The details of area to be illuminated are given in Table 1. along with the required lux levels.

**Table 1. Areas to be lit and required lux levels**

<b>Area</b>	<b>Lux</b>
Control Room	350
Battery Room	100
Computer Room	300
Entrance lobby	150
Corridor and landing	150
Switchyard - Main equipment	50
Switchyard - general equipment and balance	30
Street/Road	30



Contractor shall submit detailed calculation for verifying that the required lux levels will be attained by the proposed lighting system

Any material, cables, wire, conduits, fittings, accessories etc. whether mentioned specifically or not but required for installation of lighting fixtures are included in the scope of Contractor.

## **2.0 SYSTEM DESCRIPTION**

### **2.1 Normal lighting - AC**

AC lights will be connected to AC lighting panels. All the lights connected to the AC lighting system in different areas will be connected to the main lighting distribution boards to be supplied.

### **2.2 Emergency lighting - DC**

DC emergency lighting fixtures operated from the DC system shall be provided in strategic locations so that the operating personnel can safely find their way during a total AC failure. These lights will be normally 'OFF' and will be switched 'ON' automatically when under voltage occurs in the AC mains lighting distribution board.

### **2.3 Emergency lighting - portable**

Emergency portable light shall be provided as per relevant clause of this section. Three portable lights for control room and two portable lights for PLCC room shall be provided for every substation.

### **2.4 Temperature Rise**

All lighting fixtures and accessories shall be designed to have a low temperature rise according to IEC 598 Part-I/ IS 10322 (Part-4). Temperature rise of panels should be as per IS 8623 (Part-I)/IEC 439-1.

## **3.0 LIGHTING FIXTURES**

### **3.1 General**

Fixture shall conform to latest IS / IEC .and its latest amendment.

All fixtures shall be designed for minimum glare. The finish of the fixtures shall be such that no bright spots are produced either by direct light source or by reflection.

All lighting fixtures shall be complete with required lamps such as LED (to be fitted inside switch yard and all street light ), & LED light (adopt as per Govt norms for energy efficiency) for indoor lighting..

LED lamp fixtures shall be complete with all necessary wiring and accessories such as ballasts, ignitors, power factor improvement capacitors etc if required. These shall be mounted in the fitting assembly only. The Contractor shall indicate starting time of these lamps to attain full light output. Curves for starting characteristics with varying supply voltage etc. are to be furnished by the Contractor.

Flood lighting shall have suitable base plate/frame for mounting on structural steel member.

Each fixture (other than bulk head fixtures) shall have terminal blocks suitable for 2.5 mm<sup>2</sup> stranded flexible copper conductor. The internal wiring should be completed by the manufacturer and terminated on the above terminal blocks. The Contractor shall specifically furnish details of internal size of wires and type of insulation. The terminal blocks shall be as specified under General Equipment and Substation Accessories (GESA) section of this Specification.

Each lighting fixture shall be provided with an earthing terminal suitable for connection to 16 SWG GI earthing conductors. All metal or metal enclosed parts of the housing shall be suitably constructed so as to ensure satisfactory earthing continuity throughout the fixture up to the earthing terminal. The mounting facility and conduit knock-outs for the fixtures shall be provided and shall be suitable for 20 mm conduit entry. On completion of manufacture, all surfaces of the fixtures shall be thoroughly cleaned and degreased. The fixtures shall be free from scale, rust, sharp edges and burrs.

The housing shall be stove-enamelled or vitreous enamelled or anodised aluminium as indicated in the specification of the relevant fixture.

All enamel finishing shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surface. The finish shall be non-porous and free from blemishes, blisters and fading.

The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 degrees. over 1.5 inch die mandrel.

All light reflecting surfaces shall have optimum light reflecting coefficient so as to ensure the overall light output as specified.

The different types of lighting fixtures to be provided shall be to the approval of the OPTCL.

**REMARKS: ALL THE LAMPS TO BE USED INSIDE & OUTSIDE THE SUB-STATION AREA SHALL BE OF "LED" ONLY. BIDDERS ARE ADVISED TO QUOTE ACCORDINGLY.**

## **4.0 Accessories**

### **4.1 Reflectors**

The reflectors shall be manufactured from sheet steel or aluminium more applicable of not less than 22 SWG thickness. They shall be securely fixed and of captive type.

### **4.2 Lamp holders**

Lamp holders shall preferably be for LED lamps etc. Holders shall be designed and manufactured in accordance with relevant standard to give long and satisfactory service.

### **4.3 Ballasts (if required)**

Ballasts shall be designed, manufactured and supplied in accordance with IS 3021 and function satisfactorily under site condition specified. The ballasts shall be designed to have a long service life. The power loss in ballasts (if required) for LED lamps shall not be more than the specified watts as per relevant standard and for the fluorescent lamps it shall be the minimum commercially available in the industry.

Ballasts shall be mounted using self locking anti-vibration fixing and shall be easy to remove without dismantling the fixtures. They shall be totally enclosed units.

The ballasts shall be of the inductive, heavy duty type, filled with thermosetting, insulating, moisture repellent polyester compound filled under pressure or vacuum. The ballast wiring shall be of copper wire. Ballasts shall be designed for maximum winding temperature rise of 55 °C under rated conditions. They shall be free from hum. Ballasts for LED lamps shall be provided with suitable tapping to set the voltage within the range specified. End connections and taps shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure.

Separate ballasts for each lamp shall be provided in case of multi-lamp fixtures.

The Contractor shall submit general arrangement and wiring diagram with all terminal details for approval of the OPTCL.

### **4.4 Capacitors**

Capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.

Capacitors shall be suitable for operation at the supply voltage as specified and shall have a value of capacitance so as to correct the power factors of its corresponding lamp circuit to the extent of 0.98 lag.

Capacitors shall be hermetically sealed in a metal enclosure.

### **4.5 Lamps**

The LED lamps to be supplied shall conform to IS 9974. LED lamps shall be suitable for use in any position. Restrictions, if any, shall be clearly stated. The lamps shall be capable of withstanding small vibrations without breakage of connections at lead-in wires and filament electrodes.

The constructional features of LED lamps for special applications shall be clearly brought out in the bid.

The Bidder shall furnish typical wiring diagrams for all fittings including all accessories. The diagrams shall include technical details of accessories i.e. ignitors, ballasts, capacitors etc.

## **5.0 Receptacles**

All receptacles shall be of cast steel or aluminium, heavy duty type, suitable for fixing on wall or column and complete with individual switch.

In general the receptacles to be installed are of the following types:

- A) 15A, 240V, 2 pole, 3 pin type with third pin grounded, metal clad with gasket having cable gland entry suitable for 2 core 6 mm<sup>2</sup> PVC armoured cable and a metallic cover fixed to it with a metallic chain. Receptacles shall be suitable for installation in moist location and/ or outdoor. The switch shall be of rotary type. Receptacles shall be housed in an enclosure made out of 2 mm thick GI sheet with hinged doors with padlocking arrangements. Door shall be lined with good quality gaskets. This shall conform to IP 55.
- B) 5A and 15A, 240V, 3 pin type with third pin grounded, suitable for flush mounting. The switch shall be of piano key type and shall be flush mounted.
- C) 63A, 415V, 3 phase, 4 pin interlocked plug and switch with earthing contacts. Other requirements shall be same as type RO. The receptacle shall be suitable for 3½ core 35mm<sup>2</sup> / 3½ core 70mm<sup>2</sup> aluminium conductor cable entry and shall also be suitable for loop-in-loop-out connection of cables of identical size. Receptacle shall be suitable for outdoor application. Receptacles shall be housed in a box made out of 2 mm thick G. I. sheet, with hinged door with padlocking arrangement. Door shall be lined with good quality gaskets. This shall conform to IP 55.

## **6.0 LIGHTING POLES**

The Contractor shall supply, the following types of hot dip galvanised steel tubular lighting poles required for street lighting:

1. Type AI street lighting pole - for one fixture
2. Type EI post top lantern pole - for one fixture

Street/flood light poles shall conform to the drawings approved by the OPTCL.

Lighting poles shall be complete with fixing brackets and junction boxes. Junction boxes should be mounted above ground level at 1 mtr height from the ground.

The lighting poles shall be steel hot dip galvanised

The galvanised sheet steel junction box for the street lighting poles shall be completely weather proof conforming to IP 55 and provided with a lockable door and HRC fuse mounted on a fuse carrier and fuse base assembly. The terminals shall be stud type and suitable for two nos. 16mm<sup>2</sup> cables. Necessary arrangement for cable glands along with supply of double compression glands are included in Contractor's scope.

Wiring from junction box at the bottom of the pole (minimum height from the bottom of the pole shall be 1.0mtrs) to the fixture at the top of the pole shall be 2.5 mm<sup>2</sup> wire.

## **7.0 LIGHTING WIRES & CABLES**

The wiring used for lighting shall be of 1100V grade, PVC insulated cable of standard products of reputed manufacturers.

The conductor sizes for wires used for point wiring beyond lighting panels shall be single core 4 mm<sup>2</sup>, 6mm<sup>2</sup> and 10mm<sup>2</sup> stranded aluminium wires and 2.5 mm<sup>2</sup> stranded copper wire.

The wires used for connection of a lighting fixture from area rest junction box or for loop-in loop-out connection between two fluorescent fixtures shall be single core copper stranded conductor, 1100V grade flexible PVC insulated cords, unsheathed, conforming to IS 694 with nominal conductor cross sectional areas of 2.5mm<sup>2</sup>.

The Contractor's scope covers supply of all wiring, cabling and accessories.

The wires shall be colour coded as follows:

- Red for R – Phase
- Yellow for Y – Phase
- Blue for B – Phase
- Black for Neutral
- White for DC (Positive)
- Grey for DC (Negative)

## **8.0 TESTS AND TEST REPORTS**

Manufacturer's test certificates if required shall be submitted for the fixtures and accessories. Type test certificates shall be furnished along with the bid.

## **9.0 LIGHTING SYSTEM INSTALLATION WORKS**

### **9.1 General**

In accordance with the specified installation instructions as shown on manufacturer's drawings or as directed by Project Manager. Contractor shall supply, erect, install, test and put into commercial use all the electrical lighting equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented. Tolerances shall be as established in manufacturer's drawings or as stipulated by Project Manager.

The Contractor shall prepare the lighting layout and erection drawings and obtain the Project Manager's approval before commencing the erection works.

## **9.2 Flood lights.**

Contractor shall install flood lights on switchyard structures to be erected inside switchyard. The GI structural are also suitable for protection from lightening by providing spikes cones at all the column peak. Proper design in this respect to be carried out along with numbers of such towers required. Plotting of lightening protection area showing details of equipment installed in switch yard. A platform provided in the mast tower shall be used for fixing of lighting fixtures.

Fixtures shall be mounted on galvanised making use of shop provided holes or by suitable clamps. No cutting or drilling of galvanised structure is permitted.

The Contractor shall mount the assembled fittings and install necessary cabling.

## **9.3 Lighting fixtures for flood lights**

Flood lights shall be mounted on steel base facing the tentative direction shown on drawings. Fixing holes shall be provided with slot to turn the fixture by approximately 5 degrees on both sides. Bolts shall be finally tightened with spring washer. The Contractor shall supply and install the steel base, channels, angles etc. for fixing the flood light on the flood light towers. Terminal connection to the flood light shall be through flexible conduits, and these flexible conduits shall be included in the installation rate of fixture itself.

The scope of Contractor shall include the supply of necessary brackets and sundry material, for installation of lighting fixtures.

## **9.4 Lighting panels**

Lighting panels shall be erected at the locations to be indicated in the approved drawings.

Necessary foundations and/or supporting structures for all outdoor type lighting panels and necessary supporting structures for indoor lighting panels shall be provided by the Contractor.

## **9.5 Street lighting poles**

Street lighting poles shall be installed as per the approved drawings.

Steel tubular hot dip galvanised pole,s which are specified for the above purpose are to be installed as per the approved lay out for street lighting system. Contractor shall erect the poles (including foundation works), mount the assembled fittings and install necessary cabling.

## **9.6 Emergency Portable Lighting Fixtures**

The portable emergency lighting fixtures supplied shall have a built in battery rated for six hours and be complete with battery chargers and solid state inverters, and be supplied with all necessary supporting brackets of galvanised steel suitable for wall/column mounting..

The portable emergency lighting fixtures shall be of a single unit, completely tropicalised, suitable for prolonged use with no maintenance, and shall light up automatically in the event of failure of normal supply.

The Contractor shall submit schematic along with all details and general arrangement drawing for approval.

## **10.0 CEILING FANS AND REGULATORS**

The Contractor shall supply 1400 mm sweep ceiling fans complete with electronic regulator and switch, suspension rod, canopy and accessories.

The Contractor shall supply the switch, electronic regulator and board for mounting switch and electronic regulator.

Winding of the fans and regulators shall be insulated with Class-E insulating material. Winding shall be of copper wire.

Electronic regulator with smooth control shall be provided.

Precautions shall be taken in manufacture of fans and regulators to ensure reasonable degree of silence at all speeds.

Type tests, acceptance tests and routine tests for the fans and regulators shall be carried out as per latest relevant standard.

Fans and electronic regulators shall be from established manufacturers or brands.

## **11.0 FOUNDATION AND CIVIL WORKS**

All foundations and civil works shall be included in the Contractor's scope of work. Civil works shall be in accordance with the relevant part of this specification.

## **12.0 GROUNDING**

All lighting panels, junction boxes, fixtures, conduits etc. shall be grounded in compliance with the provision of I.E. Rules.

Ground connections shall be made from nearest available station ground grid. All connections to ground grid shall be done by arc welding.

Lighting panels shall be directly connected to ground grid by two 50 x 6mm G.S. flats.

A continuous ground conductor of 16 SWG GI wire shall be connected to each panel ground bus. All junction boxes, lighting fixtures shall be connected to this 16 SWG ground conductor.

All lighting poles shall be earthed as per standard. 16 SWG GI wire shall be taken up to junction box from the lighting fixture.

## **13.0 TESTING AND COMMISSIONING**

On completion of erection work, the Contractor shall request the OPTCL to undertake the inspection as required by this Specification.

The OPTCL shall arrange for joint inspection of the installation for completeness and correctness of the work. Any defect pointed out during such inspection shall be promptly rectified by the Contractor.

The installation shall be tested and commissioned in the presence of the Contractor and OPTCL

The Contractor shall provide all men, material and equipment required to carry out the tests.

All rectification, repairs or adjustment work found necessary during inspection, testing and commissioning shall be carried out by the Contractor, without any extra cost to the Employer.

The Contractor shall measure and furnish to the Project Manager, the actual lux level in all the areas of the substation to prove compliance to this specification.

**\*\* Armoured PVC cables are to be used for the switch yard lighting, street lighting and any other out door lighting system.**

**\*\* For indoor lighting ,each fixture shall be controlled by one switch.**

**\*\* Minimum two nos 5 Amp multi purpose power sockets with switch are to be provided in each switch.**

**\*\*\* Contractor to furnish the design details for the locations (like Switch yard area,Road street light,Control room building area,Quarter ,Gate etc), which can be adopted after approval from OPTCL. Design to be carried out as per the LUX level indicated at the beginning of this chapter.**



**TECHNICAL SPECIFICATION FOR  
LED FLOOD / NORMAL LIGHT FITTINGS 1 PH A.C OPERATION**

## PART -B

### 1.0 GENERAL DESCRIPTION

LED Flood/Normal Light luminaries of 240V, A.C,50 Hz ,suitably decided the wattage of the lamp (to be decided after detail Engineering) in Single piece High Pressure Die Cast Aluminium alloy Housing having high conductivity acting as heat sink, with Powder coating with suitable colour with distortion free, clear, Heat Resistant Toughened UV stabilized Glass in the front fixed to the die cast Aluminium frame which shall be fixed to the housing with high quality long lasting Neoprene Rubber gasket duly impregnated with insecticide and water repellent chemical on the periphery of lamp compartment by means of stainless steel screws to render it dust proof, water proof and vermin proof and having minimum IP-65 Protection conforming to IS:10322 (part-2) – 1982.

Note: The capacity LED Luminary is to be suitably decided after conducting the detail Engineering for the locations , where these Luminaries are to be used. The Locations are generally in EHV grade Sub-station switch yard area, Street Lighting, Control Room Building, Colony Quarters etc. Details design for adoption of LED Luminary system to be furnished for review of design and its acceptance. Latest practice of adoption of these system are to be strictly followed.

### 2.0 TRAINING :

Train the staff on Hardware /Software ,installation, commissioning and maintenance of the Luminaries at different locations (Different Sub-stations).

### 3.0 TECHNICAL SPECIFICATIONS:

The LED Luminaries are as per the following parameters

a	<b>Mid Power White LED's</b>	Should be of reputed make as indicated in the Tender specification.
b	Wattage of Mid Power White LED,s offered	Low power LED 5252 0.3W
c	LED Lumens	
d	Life span as per LM70( @70%) light output	>50000 Hrs. Or Better
	Lux at centre at height of 4.5 meter	>150 LUX Or Better
e	Uniformity Ratio( $E_{min.}/E_{max.}$ )(mounted at 4.5m height @90 °Angle)	>0.35 Or Better
f	Luminary Efficacy	>65 Or Better
g	Control of Distribution	Fully Cutoff
i	Driver current(With Constant Current Driver)	<100mA/LED Or Better

j	<b>Electronic Efficiency@230V</b>	<b>&gt;85% Or Better</b>
k	Beam angle of the Luminary	> 120° Or Better
l	color Temperature of LEDs	6500K to 7500K Or Better
m	P/N junction temperature (High thermal conduction must be achieved by silicon heat conducting greases as adhesive)	<85 °C Or Better
n	Luminary Body Temperature	The Body Temperature shall be <(Ambient+35° C) even after continuous burning of Luminary for 24 Hrs. <b>Or Better</b>
o	color Rendering Index(CRI)	<b>&gt;70 Or Better</b>
p	weight	Preferably less weight & may be of Maximum up to 4 Kgs (comfortably can be carried and fixed)
<b>B</b>	<b>ELECTRICAL</b>	
a	AC Input Voltage Range	100V TO 270V AC
b	AC Input frequency .( The LED circuitry shall function at an operating frequency that must be greater than 120 Hz to prevent perceptible flicker to the unaided eye over the entire voltage range specified above. )	47 ~ 53Hz
c	Power Factor (Source Power Factor varies from 0.5 Lag to 0.5 Lead)	<b>&gt; 0.95 Or Better</b>
d	Luminary Wattage variance at 100 V to 270 V	± 10%
e	Luminary Lux Levels Variance at 100 V to 270 V	± 5%

f	Total Harmonic Distortion(THD)	< 15% <b>Or Better</b>
g	Electrical Connection System	3 wire system (Phase,Neutral & Gnd)
h	System of earthing (The luminaries offered shall conform to Level-1 classification)	Solidly grounded
There shall be electrical isolation between input and output circuits		
<b>C</b>	<b>MECHANICAL</b>	
a	Construction of Casing	High Pressure Die Cast Aluminum. Should be durable for extreme climatic
b	Finish	Powder Coating and gray/black color and should be durable. The colour should not fade in extreme climate conditions.
c	Heat Sink type (It shall be designed in such a way that the heat generated within the LED source is efficiently dissipated to the surrounding atmosphere without abnormal rise in temperature. Any debris build up shall not degrade heat dissipation performance of the luminaries.	Aluminium Metal Core PCB
d	Lamp Cover	Toughened Glass or any suitable material which can be used in the extreme climate and should be durable.
e	Gross Weight and Dimensions (L x W x T) mm of Luminaries (Efforts shall be made to keep the overall outer dimensions as minimum as possible with out compromising on the performance, mainly thermal management of the luminary )	
f	Heat Dissipating Area (Luminary Rating wise)	
g	IP Level –Minimum IP 65	

#### **4.0 18W AC DOWN LIGHT**

#### 4.1 DATASHEET

#### 4.2 Applications :

Area: Indoor

Purpose: Home and Office Lighting.

#### 4.3 Features:

##### (1) Optical

- Optical pattern meets all standard Home and Office Light Standards.
- Uniform illuminance distribution.

##### (2) Power

- Switched mode constant current power supply.
- Over-heat, Over-voltage, Over-current protections are provided.
- Lightning Protection provided.

##### (3) Thermal

- Luminaire surface temperature is 48°C @ Ta=30°C, the temperature variation is controlled under 5°C.
- Junction temperature is controlled at 70°C @ Ta=30.
- Overheat protection will operate to adjust as the LED module surface reaches 80°C.

##### (4) Luminaire

- Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminaire with Aluminium acts as heat sink.
- Dust and water protection design meeting IP65 standards.
- Super-high luminaire efficacy.

#### 4.4 DETAILED TECHNICAL SPECIFICATION

##### I. Electrical Characteristics:

PARAMETER	DRIVER RESULT
Input Voltage	160 -300 V AC
Rated Power	18Watt
Maximum Power	21Watt
Efficiency	>85%
Power Factor	>0.9

Voltage Harmonics (THD)	<5%
Current Harmonics (THD)	<10%

**II. Operating Conditions:**

Operating Frequency	100kHz to 200KHz
Operating Temperature Range	-25°C to +70°C
Storage Temperature Range	-65°C to 125°C
Humidity	95% RH

**III. LED Details:**

Led Make	As per approved vendor
No Of LED's	12
Led Viewing Angle	120° by using reflector
Colour Temperature	Cool White (5500 to 6500K)
Luminous Flux	>2160 Lumens
Life Span	> 80,000 Hours
Colour Rendering Index	>70 Ra

**IV. LED Luminary Details:**

Body	Alluminium Body
Heat Sink	Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminary with Aluminium acts as heat sink.
Dust and Water protection	IP 65 Standards

**V. Protection Parameters:**

Over-Current Protection	Inbuilt
Short-Circuit Protection	Inbuilt
Over-Voltage Protection	Inbuilt
Over-Temperature Protection	135 °C
Dust and Water Protection	IP 65
Lightning Protection	Inbuilt

**5.0 50W AC LOW BAY LIGHT**

LED bay light fixture is designed and developed to replace traditional high bay or low bay fixtures for industrial and other rugged applications. Light weighted and easy for

installation, the LED High Bay/Low Bay fixtures are all designed to offer maximum energy saving, substantially reduced maintenance costs and superior quality.

### 5.1 Major Applications :

Factory production floors, Workshop, Warehouses, Road toll gates, Petrol stations, Supermarkets, Sports stadiums, Convention center halls, Airport passenger halls, etc., where high ceiling lighting required.

### 5.2 Features :

- 1) Low power consumption. More than 60% energy saving compared to conventional HID/HPS.
- 2) Environmental friendly. Lead and mercury free. Long operation life time, above 50,000hours. Low maintenance costs.
- 3) Voltage input 160-300 V AC,
- 4) Instant ON/OFF operation.
- 5) Superior color rendition compared to conventional industrial luminaries.
- 6) Selectable color temperature.
- 7) Single piece 30W-100W high power LED light source with unique multi-chip integration design ensure high light purity, high heat conduction and slow brightness derating.
- 8) Unique heat sink design ensures superior heat management.
- 9) Resistant to shock and vibration.

### 5.3 Specifications :

<b>Input Voltage</b>	AC 160-300V
<b>Power Frequency of Driver</b>	47~63Hz
<b>Power Efficiency of Driver</b>	≥85%
<b>LED Power Consumption</b>	50w
<b>Power Factor(PF)</b>	≥0.90
<b>Total Harmonic Distortion</b>	≤10%
<b>Luminaries Efficiency</b>	≥90%
<b>Flux (Lumens)</b>	4000
<b>Color Rendering Index</b>	≥80
<b>Color Temperature</b>	2700~7000K Optional
<b>Beam Angle</b>	90/120 Degree Optional
<b>Light Effect</b>	70~80lm/W
<b>Working Ambient Humidity</b>	-25°C~+45°C
<b>Working Ambient Humidity</b>	15%~90%RH
<b>IP Rating</b>	IP30/IP54 Optional

<b>Service Life</b>	≥50000 Hours
<b>Light Fixture Material</b>	Aluminum Alloy

## **6.0 100W AC LED STREET LIGHT**

### **6.1 DATASHEET**

### **6.2 Applications :**

Area: Outdoor

Purpose: Street and Roadway Lighting.

### **6.3 Features:**

#### (1) Optical

- Optical pattern meets all standard Street Light Standards.
- Uniform illuminance distribution.

#### (2) Power

- Switched mode constant current power supply.
- Over-heat, Over-voltage, Over-current protections are provided.
- Lightning Protection provided.

#### (3) Thermal

- Luminaries surface temperature is 48°C @ Ta=30°C, the temperature variation is controlled under 5°C.
- Junction temperature is controlled at 70°C @ Ta=30.
- Overheat protection will operate to adjust as the LED module surface reaches 80°C.

#### (4) Luminaire

- Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminaire with Aluminium acts as heat sink.
- Dust and water protection design meeting IP65 standards.
- Super-high luminaire efficacy.

## **6.5 DETAILED TECHNICAL SPECIFICATION**

### **Electrical Characteristics**



PARAMETER	PROMPT DRIVER RESULT
Input Voltage	160 -300 VAC
Rated Power	100W
Maximum Power	115W
Efficiency	>85%
Power Factor	>0.9
Voltage Harmonics (THD)	<5%
Current Harmonics (THD)	<10%

## II. Operating Conditions:

Operating Frequency	100kHz to 200KHz
Operating Temperature Range	-25°C to +70°C
Storage Temperature Range	-65°C to 125°C
Humidity	95% RH

## III. LED Details:

Led Make	As per approved vendor
No of LED's	48-70
Led Viewing Angle	120° by using reflector
Colour Temperature	Cool White (5500 to 6500K)
Luminous Flux	>8500 Lumens
Life Span	> 50,000 Hours
Colour Rendering Index	>70 Ra

## IV. LED Luminary Details:

Body	Alluminium Die casting Body
Heat Sink	Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminary with Aluminium acts as heat sink.
Protection	IP 65 Standards for Dust and Water

## V. Protection Parameters:

Over-Current Protection	Inbuilt
Short-Circuit Protection	Inbuilt
Over-Voltage Protection	Inbuilt

Over-Temperature Protection	135 °C
Dust and Water Protection	IP 65
Lightning Protection	Inbuilt

## **7.0 120W AC LED FLOOD LIGHT**

### **7.1 DATASHEET**

#### **7.2 Applications :**

Area: Outdoor

Purpose: Street and Roadway And Area Lighting.

#### **7.3 Features:**

##### (1) Optical

- Optical pattern meets all standard Street Light Standards.
- Uniform illuminance distribution.

##### (2) Power

- Switched mode constant current power supply.
- Over-heat, Over-voltage, Over-current protections are provided.
- Lightning Protection provided.

##### (3) Thermal

- Luminaries surface temperature is 48°C @ Ta=30°C, the temperature variation is controlled under 5°C.
- Junction temperature is controlled at 70°C @ Ta=30.
- Overheat protection will operate to adjust as the LED module surface reaches 80°C.

##### (4) Luminaire

- Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminaire with Aluminium acts as heat sink.
- Dust and water protection design meeting IP65 standards.
- Super-high luminaire efficacy.

## **7.4 DETAILED TECHNICAL SPECIFICATION**

### **I. Electrical Characteristics**

PARAMETER	PROMPT DRIVER RESULT
Input Voltage	160 -300 VAC
Rated Power	120W
Maximum Power	140W
Efficiency	>85%
Power Factor	>0.9
Voltage Harmonics (THD)	<5%
Current Harmonics (THD)	<10%

### II. Operating Conditions:

Operating Frequency	100kHz to 200kHz
Operating Temperature Range	-25°C to +70°C
Storage Temperature Range	-65°C to 125°C
Humidity	95% RH

### III. LED Details:

Led Make	As per approved vendor
No of LED's	48-70
Led Viewing Angle	120° by using reflector
Colour Temperature	Cool White (5500 to 6500K)
Luminous Flux	>8500 Lumens
Life Span	> 50,000 Hours
Colour Rendering Index	>70 Ra

### IV. LED Luminary Details:

Body	Alluminium Die casting Body
Heat Sink	Optimized thermal design to ensure maximum life to LED. The Heat sink grade aluminium has the highest surface area for efficient heat diffusion and the entire luminary with Aluminium acts as heat sink.
Protection	IP 65 Standards for Dust and Water

### V. Protection Parameters:

Over-Current Protection	Inbuilt
Short-Circuit Protection	Inbuilt
Over-Voltage Protection	Inbuilt
Over-Temperature Protection	135 °C

Dust and Water Protection	IP 65
Lightning Protection	Inbuilt

**NOTE:**

The contractor has to design the requirement as per the lux level indicated in Table-1A above & the said quantity if exceeding the minimum recommended quantity the contractor has to supply the quantity as required as per the design and should not be less than the minimum recommended quantity. Minimum Nos of fittings recommended are as below :

Outside Control Room : 1) 120W AC LED – 4nos. 2) 100W AC LED – 06nos.

Inside Control Room : 1) As per the desiogn

Ceiling fan:1400 mm Sweep: 06 Nos

Exhaust fan: 300 mm Sweep:04 Nos

**TECHNICAL SPECIFICATION  
FOR  
AIR CONDITIONING**

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OF  
AIR CONDITIONING

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## **TECHNICAL SPECIFICATION FOR AIR CONDITIONING SYSTEM**

### **1.0 GENERAL**

The scope covers supply, installation, testing and commissioning of Air conditioning system for the control room building.

**1.1.** Air conditioning requirement of rooms indicated shall be met by using **6nos. 1.5 Ton each 5 star rated** split AC units.

**1.2** Copper refrigerant piping complete with insulation between the indoor and remote outdoor condensers as required.

### **2.0 SCOPE:**

The scope of the equipment to be furnished and services to be provided under the contract are outlined herein and the same is to be read in conjunction with the provision contained. The scope shall be deemed to include all such items which although not specifically mentioned in the bid documents and/or in bidders proposal, but are required to make the equipment/system complete for its safe, efficient, reliable and trouble free operation of hermetically sealed.

### **3.0 Drain pipe**

PVC drains piping from the indoor units up to the nearest drain point to be done.

**3.1** Power and control cables between the indoor unit and out door unit and Earthing are to be provided.

**3.2** GI brackets for outdoor condensing unit and proper earthing.

### **4.0 Specification for Split AC units.**

The split AC units will be complete with indoor evaporator unit, outdoor condensing units and cordless remote control units.

Outdoor units shall comprise of hermetically sealed reciprocating/rotary compressors mounted on vibration isolators, propeller type axial flow fans and copper tube aluminium finned coils assembled in a sheet metal. The casing and the total unit shall be properly treated and shall be weather proof type. They shall be compact in size and shall have horizontal discharge of air.

The indoor unit shall be high wall type. The indoor unit shall be compact and shall have elegant appearance. They shall have low noise centrifugal blowers driven by special motors and copper tube aluminium finned cooling coils. Removable and washable polypropylene filters shall be provided. They shall be complete with multifunction cordless remote control unit with special features like programmable timer, sleep mode and softy dry mode etc.



# **TECHNICAL SPECIFICATION**

## **FOR**

**TESTING INSTRUMENTS AND MAINTENANCE KITS  
OTHER TOOLS & PLANTS  
&  
OFFICE FURNITURE**

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OF  
TESTING INSTRUMENTS, T&P AND OFFICE FURNITURE

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17.0	Office Furniture	10

## **1.0 GENERAL**

The testing and maintenance equipment covered here are generally meant for carrying out testing and measurement at site and shall be complete with all materials and accessories. These shall be robust in design, so that they give accurate results even in adverse site conditions.

All equipment furnished shall be of reputed make, type tested and shall be subjected to acceptance and routine tests in accordance with the requirements stipulated under respective equipment specification.

At least two sets of descriptive leaflets, catalogues, outline drawing, principles of operation etc. shall be sent along with the offer, for all the equipment offered. Weight and dimensions of items should also be mentioned.

Four sets of inspection and calibration report, operation and maintenance manual shall be sent along with Despatch documents. One set will be kept inside the equipment.

In the event of bidder offering equipment manufactured by different manufacturers, it will be his responsibility to fully co-ordinate the activities of each manufacturer in such a way that the complete equipment contracted for, is manufactured, supplied and guaranteed for successful operation.

## **2.0 TRAINING**

Necessary training shall be provided to Employer's personnel for using and maintaining the equipment at Employer's premises for the testing equipment supplied if required.

## **3.0 CLIMATIC CONDITION**

The equipment covered under this specification shall be suitable for operation under climatic condition stated at chapter E3 of technical specification. The offered equipment as such shall be suitable for satisfactory operation under the tropical climate.

## **4.0 100 KV TRANSFORMER OIL BREAKDOWN VOLTAGE TEST SET**

The equipment offered shall be suitable for determination of electric strength (breakdown voltage) of insulating oil upto 100 KV to IS:335 (latest thereof) when measured in accordance with IS:6792.

The test cell shall be as per IS:6792 suitable for BDV upto 100 KV without external flashover.

The unit shall be of composite type having control unit and high voltage transformer in a common cabinet with necessary partition. HV chamber interlocking and zero start interlocking shall be provided.

The unit shall have motorised drive to increase voltage linearly as per the rate specified in IS:6792. Provision should also be available for manual increase of voltage. The unit shall be complete with test cell, stirrer and "GO" and "NO GO" gauge for adjusting the gap.

The instrument shall have

- 1) Operating temperature: 0 – 50 deg C
- 2) Humidity > 90% and nearly equals to 99%
- 3) Low/High level interlocking for drive motor. Earth open interlocking,reverse interlocking.
- 4) Protection: Quick acting D.C relay to isolate the H.T.
- 5) Test cup: The test cup with cover shall be made of Methylene Mathacrylate(Acrylic) having oil between 300 and 500 ml, with adjustable and removable mushroom head and ground to adjust the electrode gap distance.
- 6) Motorised and manual operation.
- 7) A linear scaled A.C rectifier voltmeter marked kV to measure output voltage.
- 8) Shall have magnetic strainer provision for removing the bubbles.

The equipment shall be suitable for operation at 240 volts 50 Hz. Single phase AC supply.

## **5.0 INSULATION RESISTANCE TESTER (MEGGER)**

The equipment offered shall be used for measurement of insulation resistance of electrical equipment.

### **5.1 Technical Requirements**

Rated voltage selection	: 1, 2, 3, 4, and 5 kV (DC Volts)
Rated resistance (megohms)	0 to 100000 multi-range type. Resistance range for each rated voltage shall be indicated in the offer.
Type	Portable, compact and direct reading type of multi-voltage with multi-rated resistance ranges. The tester shall be suitable for hand operation as well as operation by a continuously rated motor with AC mains supply of 230V, single phase, 50 Hz.
Ambient temperature	0 to 50C

Infinity adjustment leather carrying case	There should be provision The instrument shall be supplied with 7 metre long mains leads (shall have insulation level as per required) and leather carrying case.
Standards	The tester shall generally comply with the requirements of IS:2992-1987 and IS:11994-1986 and latest.
Preferable make	The equipment offered shall be of reputed make preferably Megger/ Avo International make or equivalent(on approval of OPTCL)
Other required spec.	High voltage indication by LED for user safety Auto discharge of capacitive load with indication after the IR test. Recessed terminals and shrouded leads for enhanced user safety. Linear and accurate reading Protected against accidental connection to 230/440 V AC supplies. Portable and light weight suitable for field and Lab use.

## 5.2 Test Requirements

Type test certificate for all ten tests as per Cl.11.1 of IS:2992.

All routine tests as per Cl.11.3 of IS:2992 shall be conducted.

## 6.0 OIL SAMPLING BOTTLE

Oil Sampling bottles shall be suitable for collecting oil samples from transformers, for testing of the oils (BDV, Dissolved Gas Analysis, resistivity etc). Bottles shall be robust enough, so that no damage occurs during frequent transportation of samples from site to laboratory.

Oil sampling bottles shall be made of stainless steel having a capacity of 1 litre.

Oil sampling bottles shall be capable of being sealed gas-tight and shall be fitted with cocks on both ends.

The design of bottle and seal shall be such that loss of hydrogen shall not exceed 5% per week.

An impermeable oil-proof, plastic or rubber tube of about 5 mm diameter, and of sufficient length shall also be provided with each bottle along with suitable connectors to fit the tube on to the oil sampling valve of the equipment and the oil collecting bottles respectively.

## **7.0 RELAY TOOLS KITS (ALSO REFER THE SPECIFICATION OF PCM)**

The relay test kit shall consist of the following minimum items:

1. Test plugs for use with testing equipment
2. Special type test plugs for using with modular type cases
3. Screw driver set with multiple fixing feature
4. Long nose pliers
5. Wire cutting pliers and stripper
6. Ordinary pliers
7. Adjustable wrench
8. Soldering irons of
  - o) Watts rating - 1 No.
  - p) Watts rating - 1 No.
  - q) Watts rating - 1 No.
9. De-soldering pump
10. Printed Circuit Card-extender; Printed circuit card - 'Puller' Suitable for all supplied relays
11. Test leads (Pair with 2 Mts. length) - 1 set
12. Shorting plugs, 'pistol' prods (2 Nos.) - 1 set

## **8.0 SF6 GAS LEAK DETECTOR**

The SF6 gas leak detector shall meet the following requirements

The detector shall be free from induced voltage effects.

The sensing probe shall be such that it can reach all the points on the breaker where leakage is to be sensed. Latest standard in this effect may be followed.

## **9.0 Digital Multimeter**

The digital multi meter shall have a LCD screen for displaying 3 and 3/4 digits and having auto ranging facility. Instrument shall have single rotary selection switch. Instrument shall have automatic polarity, low battery and over range indication and a range of 0.1mV to 1000V DC, 0.1mV to 750V AC, 0 -10A DC , 0-10 A ,AC and 0-10 mega ohm . Instrument shall have auto selection of AC/DC ampere and AC/DC Voltage. It shall have auto power off and data hold facility. Instrument shall have

rugged casing and other measurement facilities (resistance, diode, continuity etc measurement) as per standard.

#### **10.0 Digital clamp-on- meter: (AC)**

The digital clamp meter shall have LCD screen for displaying 3 and 3/4 digits, multifunction, 1000 Ampere range of AC current at (i) 0.01 Amp to 20 Amp, (ii) to 200Amp and (iii) to 1000Amp; AC/DC voltage range 0.01 V to 200V and in the other scale up to 1000V, Provision of measurement of resistance up to 0 – 10 mega ohms at different scale selection and also other facilities. Instrument shall have single rotary selection switch. It shall have auto power off and data hold facility. Instrument shall have rugged casing and other measurement facilities (resistance, diode, continuity etc measurement) as per standard.

#### **11.0 Digital Earth Tester.**

The digital earth tester shall have 4 points ,three range ( 0 .01 ohms to 20 ohms, 200 ohms and up to 2000 ohms) type. Battery operated type instrument.3 and 1/2 digit LCD display with maximum reading 1999 ohms. Instrument shall have rechargeable internal Ni-MH Battery. Instrument shall be of 4 wire soil resistivity measurement. Type tested as per IS-9223.Instrument shall have low bat indication and data hold facility. Instrument shall have over range indication. Single, measuring time below 1 minute. Instrument shall consist of required nos of standard length of spikes (minimum 1 mtr), flexible copper PVC wires of required length (minimum length shall be 30mtrs two pieces and 15 mtrs two pieces ,and two more pieces for connecting to the instrument), one no. suitable hammer for hammering the spike for inserting into the earth. There shall be crocodile clamps on one side of each wire and round clips on the other side for connecting to the instrument.

#### **12.0 Discharge Rods:**

Discharge rods shall be good quality and as per the latest relevant standard. Required length of PVC good insulation flexible copper cable, required clamp connected at the end of wire shall be connected. The top portion of the discharge rod shall be adjustable to fit in for proper gripping by screwing from the bottom side. The entire handle shall be of latest insulating materials for the safety of the user. The discharge rod shall be reliable, durable and shall meet the safety requirement of the users.

#### **13.0 Rubber Hand Gloves:**

Good quality rubber gloves for using during operation of isolators and earth switch. Latest standard for the rubber gloves shall be followed. The gloves shall be reliable, durable and shall meet the safety requirement of the users.

#### **14.0 Portable Emergency Light:**

Reputed make (BPL/CGL/Bajaj) portable emergency light, having twin tube, shall be supplied to each sub-station. It shall have chargeable battery (durable) and

having provision of selection switch for selecting single or double tube. It shall have chargeable feature during not in use and automatically switch on in the event of power failure. CFL tubes are preferred. It shall have provision of wall hanging/table mounting and shall be durable one. Latest standard in this effect shall be followed.

## 15.0 SCHEDULE OF REQUIREMENTS OF MAINTENANCE TESTING EQUIPMENT

### SCHEDULE - I

Item nos.	Units	33/11 KV S/S
100 kv transformer oil breakdown voltage test set	Nos	1
Insulation resistance tester (megger)	Nos	1
Oil sampling bottle	Nos	4
SF6 gas leak detector	Nos	1
LCD, clamp on meter	Nos	1
Line Tester	Nos	1
Digital earth tester	Nos	1(for whole package)
Discharge rod as per standard for carrying out the switch yard maintenance work	Nos	6
Rubber gloves of operation of isolators and earth switch	Pairs	3
Relay tools kit(as per clause 7.0 of chapter E-20)	Sets	1
Portable emergency light	Nos	1
First Aid Box	Sets	1
Rubber Mat(infront of Panels)	Nos	10
Aluminium Ladder(10 Mtr.)	Nos	1
Sock treatment chart	Nos	2

\*\* The Line Tester, clamp on meters, earth tester shall be of reputed make Fluke, Megger, Motwane. The discretion of selection of make lies with OPTCL. Prior approvals of OPTCL for all the testing equipments are to be taken.



**16.0 OTHER TOOLS AND PLANTS (T&P'S) REQUIREMENT:**

**SCHEDULE- II**

Following T&P's of reputed make are also in the scope of this contract.

Sl No	Description of Items	unit	
			<b>33/11 KV S/S</b>
1	Set of "D" spanner(6mm – 42mm)	Set	1
2	Set of "Ring" spanner(6mm – 42mm)	Set	1
3	Socket wrench with sockets,handles,and other attachment(6mm-42mm)	Set	1
4	Insulated cutting plier	Nos	1
5	Insulated nose plier	Nos	1
6	Monkey plier	Nos	1
7	Circlip plier	Nos	1
8	Pipe wrench a)12 inch – 1 no b)18 inch – 1 no	Set	1
9	Sly wrench a)12inch – 1 no b)18inch – 1 no	Set	1
10	Insulated handle screw drivers of different sizes as per required a)12inch plain head – 1 no b)8inch plain head – 1 no c) 12inch star head – 1 no d) small size6inch plain and star head – 1 each e)Complete set of different head in one box/set -1set	Set	1
11	"L"-N keys set of different sizes in one box/set	Set	1
12	M.S Files(12inch and 6inch sizes) Round files and flat files-one each of different sizes)	set	1
13	Hammar with handle a)1 lb – 1 no b)1/2 lb-1 no c)2 lb-1 no	Set	1
14	Crow bar a)5 ft – 1no b)3ft- 1no	set	1

15	Steel scale(12inch)	Nos	1
16	Steel tape a)5 mtrs-1 no b)30mtrs-1 no	Set	1
17	Oil cane	Nos	1
18	Spirit level (8inch)	No	1
19	Plumb head with string and attachment	No	1
20	Maintenance safety belt with all attachment and helmets(complete one set)	Set	3

\*\* All the T&P's shall be of Taparia/Zedore/Tata make. The hand drill and vacuum cleaner shall be of Rallies wolf and Eureka Forbes make.

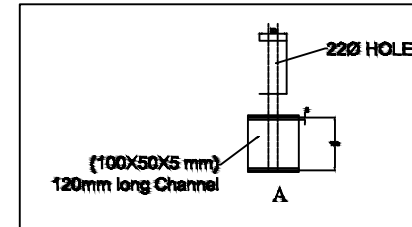
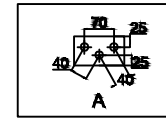
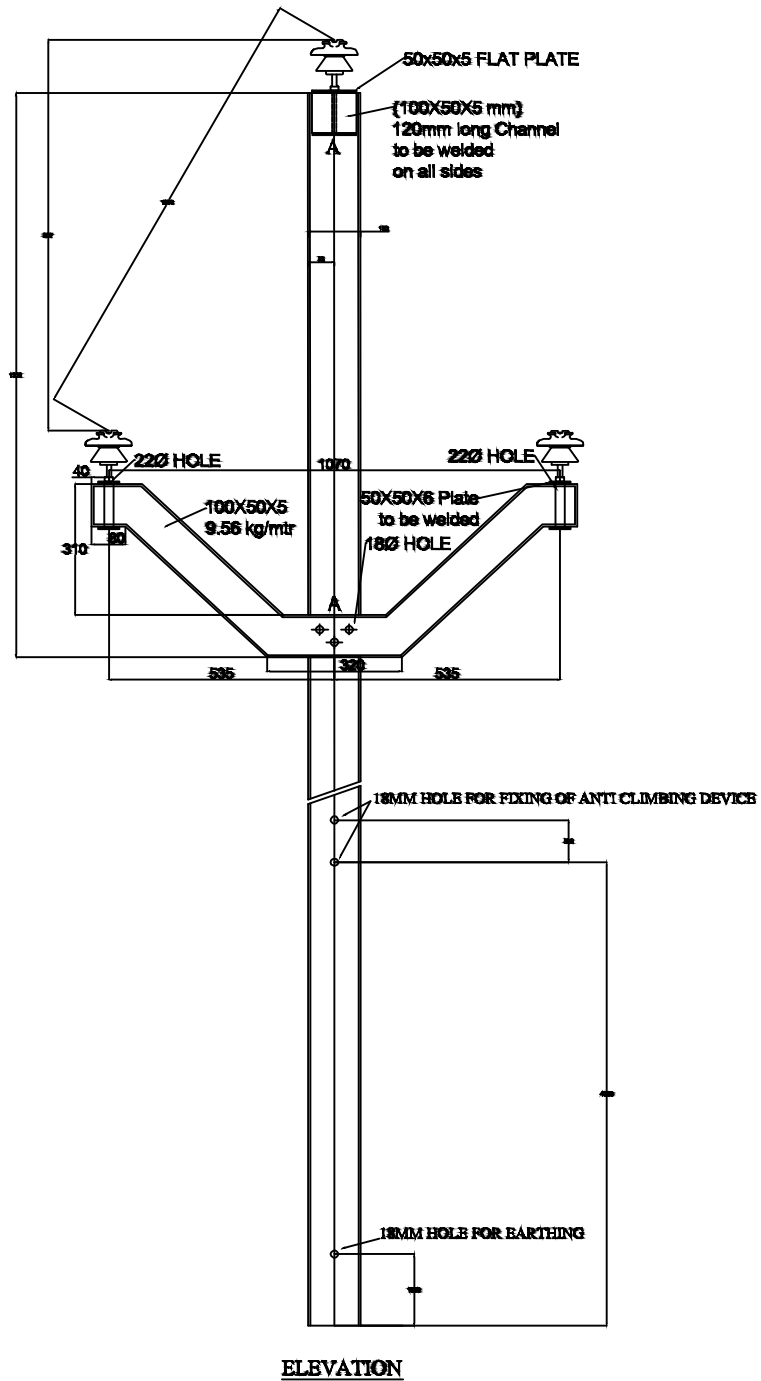
### 17.0 OFFICE FURNITURE:

Supply and installations of the office furniture are in the scope of this contract. All the furniture shall be of Godrej & Boyance make. Before supply of the furniture to the sub-station, approval from OPTCL is required. Details of the scope of supply are as indicated below.

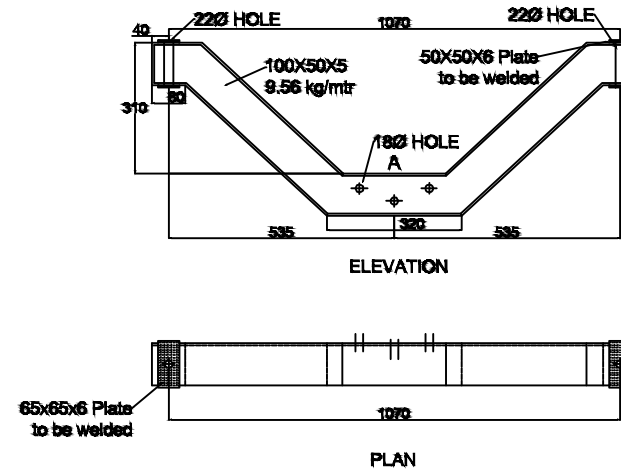
#### SCHEDULE – III.

Sl No	Description of Items	unit	
			<b>33/11 KV S/S</b>
1	5ftX3ft executive table with drawer both sides	Nos	2
3	Computer table suitable keeping monitor,CPU,UPS and printer with two nos revolving arm chair suitable for computer use.	Set	1
4	Executive revolving ,adjustable(height) chairs with arm	Nos	2
5	Cane gutting “S” type steel chairs with arm	Nos	4
7	6ft height steel almirah (only with selves) for keeping records and other valuable items	Nos	1
10	4ft steel rack (Five selves) for keeping the files and other items	Nos	1

# 11Kv V-CROSS ARM FOR RS JOIST

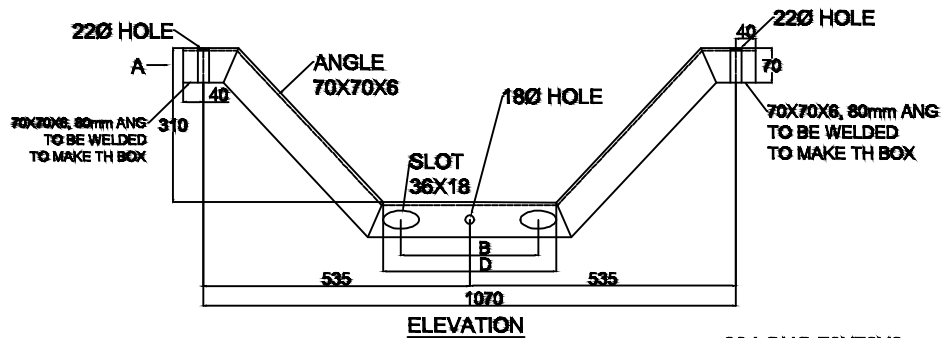


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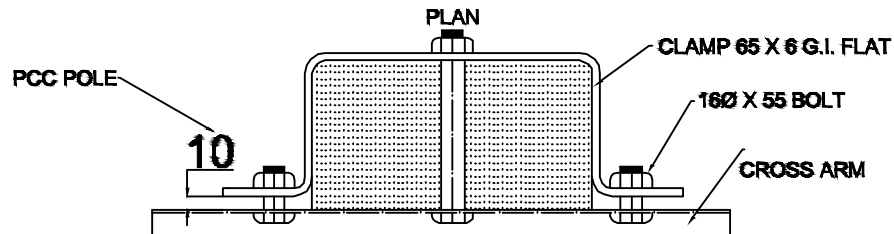
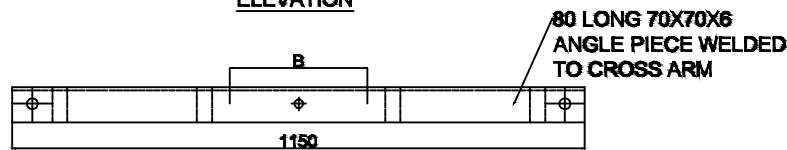


# 11 KV V-CROSS ARMS WITH TOP BRACKET & BACK CLAMP FOR PSC POLE

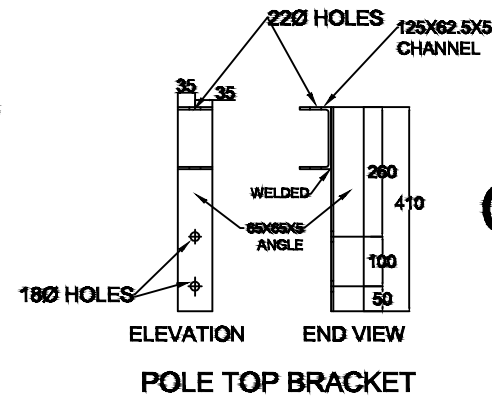
FABRICATED FROM 70X70X6 G.I. ANGLE



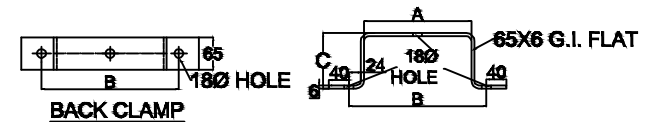
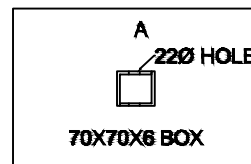
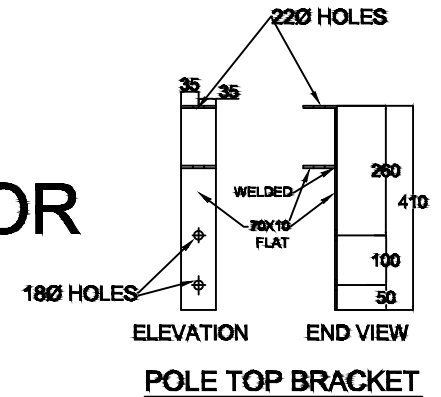
LENGTH OF POLE (L)	LOAD(KG)	A	B	C	D	BUTOM LINE OF X-ARM FROM TOP OF THE POLE IN mm
10000 mm minimum	330	216	276	111	362	1170

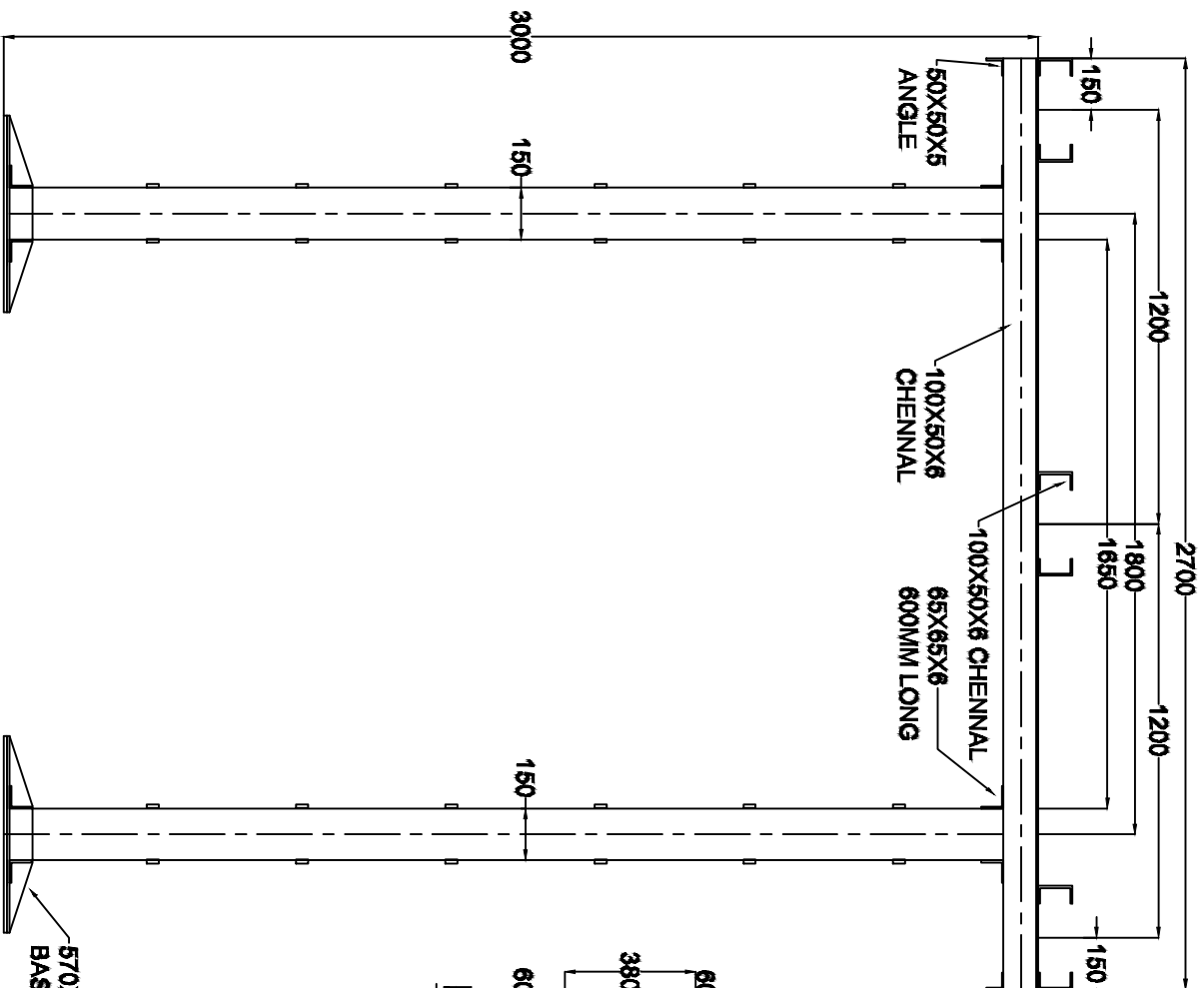


BACK CLAMPS & CROSS ARM ASSEMBLY

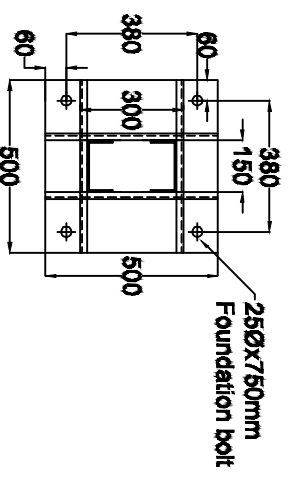


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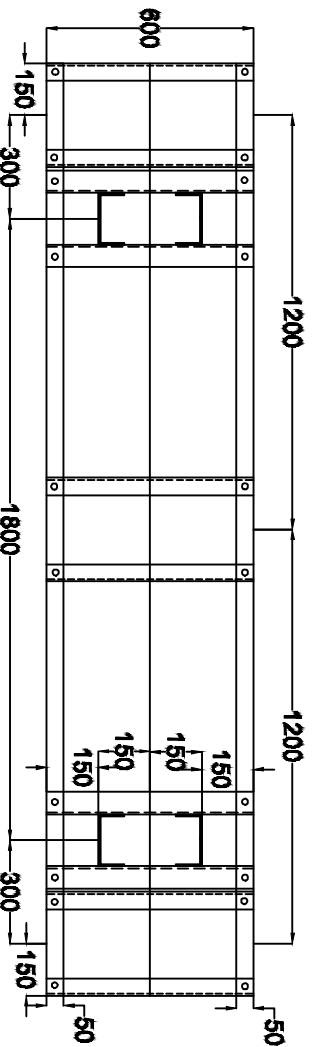




**33 kV SI STRUCTURE  
(OUTDOOR)**



**BASE PLATE**



**ELEVATION**

**PLAN**