

## Annexure-I

### Eligibility Criteria for Single Entity (Sole Bidder)

Bidding is open to all bidders who satisfy the qualification criteria set forth in the bidding documents with respect to their experience and financial capabilities. The contract shall be awarded to contractors as per NMRCL policy.

The bidding is open to the Electrical Contractors registered with Central Government / State Government / Public Sector Undertaking / Urban Local Body in appropriate class

1. Contractor shall have completed similar type of work such as Erection / Shifting work of L.T. & H.T. line, underground cable work including commissioning in single order.
2. Average Annual Turnover of last three financial years (**2013-14,2014-15, 2015-16**) shall not be less than **Rs.70 lakh**.
3. Should have executed a similar type of work underground cable in single order of value equivalent to at least **Rs.166 lakh** of the estimated cost in last three years. **OR** two orders each of **Rs.104 lakh** of the estimated cost in last three years. **OR** Three orders each of **Rs.83lakh** of estimated cost in last three years. With any State Government/Central Government/ Public sector Undertaking (PSU)/Urban local bodies during the last preceding five financial years. The completion certificate from the officer not below the rank of Executive Engineer of the concerned department should be submitted.
4. Should have valid electrical license.

### **Eligibility Criteria for JV/Consortium**

The bidder may be a sole bidder or a group of two bidders jointly together as JV/Consortium to bid for the work and to execute if awarded. In case the bidder is a sole bidder then he must comply with the criteria mentioned above. In case the bidder is a JV/consortium then following criteria shall apply.

1. Contractors shall have completed similar type of work such as Erection / Shifting work of L.T. & H.T. line, underground cable work including commissioning in single order.
2. A maximum number of two bidder can join to form a JV/Consortium.
3. The lead member should have as share more than 51% in JV/Consortium and 2<sup>nd</sup> JV member not less than 25%.
4. Both the members' must have at least 3 Years' experience as prime contractor in Electrical works.

5. The lead member should be the member who has completed similar type of work such as Erection / Shifting work of L.T. & H.T. line, underground cable work including commissioning in single order.
6. Both members jointly should have experience of supply and laying underground power cable.
7. Average annual turnover for last three financial years (2013-14, 2014-15, 2015-16) shall not be less than **Rs.70 lakh** and will be evaluated by multiplying the average annual turnover of each member with their respective shares in the JV/Consortium proposed.
8. Similar type of work shall be evaluated as follows: -
  - a) Should have executed similar type of work in two contracts each of the member should have completed one work amounting to their respective share in the JV/Consortium and total value two contracts should not be less than **Rs.166 lakh** in last three years. With any State Government/Central Government/ Public sector Undertaking (PSU)/Urban local bodies during the last preceding three financial years. The completion certificate from the officer not below the rank of Executive Engineer of the concerned department should be submitted
  - b) Should have executed similar type of work in three contracts, the lead member should have completed at least two works with total value of **Rs. 166 lakh** and other consortium member should have completed one work amounting **Rs.42lakh** in last three years. With any State Government/Central Government/ Public sector Undertaking (PSU)/Urban local bodies during the last preceding three financial years. The completion certificate from the officer not below the rank of Executive Engineer of the concerned department should be submitted
  - c) The experience of above work in point No 8.should have been in State Govt./ Central Govt./PSU/ULB during as three years.
9. Both the member of JV/Consortium should have valid Electrical licenses.
- 10.Both the member JV/Consortium should be registered as Electrical Contractor With State Govt./Central Govt./PSU/ULB.
- 11.The members participating in consortium/JV for the bid shall be jointly and severally Responsible for all liabilities relating to the work and in accordance with the terms of contract agreement.

## Annexure-II

### SCHEDULE- B

Sr. No.	DSR	Description	Qty.	Unit	Rate	Amount
1	7.3.13	Supplying , erecting & terminating 3 x 300 sq mm 11 KV, XLPE(E) round armoured cable to be laid in trench / pipe in an approved manner as per specification No CB-HT or latest.	1940	Mtr.	2110.00	4093400.00
2	MSEDCL specification	Supplying , erecting & terminating 3 x 300 sq mm 33 KV, XLPE(E) round armoured cable to be laid in trench / pipe in an approved manner as per specification No CB-HT or latest.	2095	Mtr.	3540.00	7416300.00
3	7.1.29	Supplying, erecting & terminating PVC armoured cable 3½ core 185 sq mm aluminum conductor with continuous 12.97 sq mm (8 SWG) G.I. earth wire complete with glands & lugs, on pole or laid in trench/ pipe as per specification no. CB-LT/AL or latest.	352	Mtr.	1061.00	373472.00
4	5.2.15	Supplying and erecting mini feeder pillar triple pole with 300A FPMCCB as incomer and 3 outgoing circuits with HRC Fuse base and Cartridge of 100A consisting of aluminium bus bar 500V 300A complete erected in 14 gauge CRCA sheet box with supporting angles, self locks, gasket and slanting top to be erected on foundation as per specification No. SW-SWR/MFP	30	Each	48487.00	1454610.00
5	16.3.4	Providing Cement concrete foundation for panel in 1:2:4 with required size and length of foundation (cost with wooden box is included).	70.1	Cu.Mtr	5673.00	397677.30
6	8.8.3	Dismantling of existing overhead line including G.I. wires of all sizes without damaging & making the coils in suitable sizes and transporting to MSEDCL depot/ store.	3.275	Km	816.00	2672.40
7	7.5.16	Supplying ,providing and erecting Heat shrinkable outdoor termination kit for 11 KV XLPE HT cable 3x240 to 300 sq. mm. with necessary material as per specification No. CB-JT/HT or latest.	6	Each	15127.00	90762.00

8	7.5.18	Supplying ,providing and erecting Heat shrinkable outdoor termination kit for 33 KV XLPE HT cable 3x240 to 400 sq. mm. with necessary material as per specification No. CB-JT/HT or latest	8	Each	38670.00	309360.00
9	7.4.11	Supplying ,providing and erecting epoxy outdoor end termination kit for LT PVC armoured cable 185 to 300 sq. mm. with necessary material as per specification No. CB-JT/LT or latest	4	Each	1605.00	6420.00
10	7.5.25	Supplying, providing & erecting Heat shrinkable Straight through joint kit for 11 KV XLPE HT cable 3x300 to 400 sq. mm. with necessary material as per specification No. CB-JT/HT or latest.	6	Each	28306.00	169836.00
11	7.5.27	Supplying, providing & erecting Heat shrinkable Straight through joint kit for 33 KV XLPE HT cable 3x300 to 400 sq. mm. with necessary material as per specification No. CB-JT/HT or latest.	6	Each	88404.00	530424.00
12	9.1.3	Providing earthing with Galvanised cast iron earth plate size 60 x 60 x 0.6 cm with funnel with a wire mesh for watering and brick masonry block C.I. cover complete with all materials, testing & recording the results as per specification No. EA-EP or latest.	14	Each	5234.00	73276.00
13	9.2.3	Supplying and erecting G.I. strip of required size used for earthing purpose with necessary GI clamps fixed on wall painted with bituminous paint in an approved manner with joint required. as per specification No (EA-EP).	49.5	Kg	158.00	7821.00
14	8.8.2	Dismantling of existing poles above 6 m height with brackets, clamps, insulators, stay from the cement concrete foundation and making the site clear by refilling the pits with excavated materials and bringing it to the ground level.	65	Each	615.00	39975.00

15	10.2.18	Supplying and erecting fencing of section having size 2450 mm in height from ground level and 1200 mm width with angle iron frame work erected in C C foundation and painted as per specification No SS-AS/FSG or latest.	20	Each	5286.00	105720.00
16	10.2.19	Supplying and erecting 50 x 50 x 6 mm. angle iron as corner support 2m long fixed at the middle of the fencing frame and the other side inclined at 30 degree angle, in C.C. foundation of 15 x 15 x 40cm complete duly painted with one coat of red oxide and two coats of aluminum paint.	15	Each	1060.00	15900.00
17	10.2.20	Supplying and erecting double leaf hinged door each 1500mm in width x 1850 mm in height using B class GI pipe with angle iron supports, chain link wire mesh (jali) complete supported on channel iron, erected in foundation, and painted as per specification no SS-AS/DLD or latest.	15	Each	16158.00	242370.00
18	MSEDCL specification	Bore Horizontal With HDPE Pipe up to 130 MM Dia. For laying of cables crossing of roads across / along the road.	150	Mtr	5602.00	840300.00
19	MSEDCL specification	Bore Horizontal With HDPE Pipe up to 150 MM Dia. For laying of cables crossing of roads across / along the road.	170	Mtr	7500.00	1275000.00
20	7.6.6	Supplying & laying (including excavation) 15 cms. dia half round RCC Hume pipe of standard thickness at required depth up to 90 cms. below road / ground surface, for enclosing cables & necessary back filling with light ramming to make the road/ground surface as it was (Except bitumen carpet)	700	Mtr	472.00	330400.00
21	7.6.8	Supplying & laying (including excavation) 25 cm Dia half round RCC Hume pipe of standard thickness at required depth up to 90 cms. below road / ground surface, for enclosing cable & necessary back filling with light ramming to make the road/ground surface as it was (Except bitumen carpet).	1000	Mtr	577.00	577000.00

22	10.1.2	Supplying and erecting approved make 100 kVA, 3 phase, 50 c/s Oil immersed and naturally cooled indoor /outdoor type copper wound transformer with delta connection on LV side with additional neutral brought out on load side, voltage rating 11/0.415kV with HV taping of +/- 2.5% - 5% continuously rated for full load with standard accessories complete with Test Certificate with losses below 220 watts at no load, 1800 watts at full load as per IS:2026) specification no SS-TR.	1	each	199575.00	199575.00
23	10.3.2	Dismantling existing pole mounted Distribution Transformer safety without any damages and storing it in safe place.	650	kVA	31.00	20150.00
24	10.1.4	Supplying and erecting approved make 200 kVA, 3 phase, 50 c/s Oil immersed and naturally cooled indoor /outdoor type copper wound transformer with delta connection on LV side with additional neutral brought out on load side, voltage rating 11/0.433kV with HV taping of +/- 2.5% - 5% continuously rated for full load with standard accessories complete with Test Certificate with losses below 500watts at no load, 3000 watts at full load as per IS:2026) specification no SS-TR.	1	each	310776.00	310776.00
25	10.3.3	Dismantling existing DO/AB switch set complete from D.P.structure in approved manner Note- The rate for item no 10.3.3 are for dismantling and handling over to section office inclusive of transportation upto 25 km, between site and section office	2	set	197.00	394.00

26	8.4.25	Supplying & erecting end pole D.P.structure for 100kVA Transformer with R.S.J. Pole 2Nos. Of size 100 * 116 mm * 11 Mtr. Long with suitable distribution box of C.R.C.A. sheet 16 SWG (size 4 SqMtr.) with 4 pole MCCB 100 Amps kitkat for outing ckts. Transformer D.P.structure includes the A.B. switch 200 Amps. D.O. fuse set & L.A. set 2 Nos. top channel of size 100mm *50mm for erection of A.B. switch & 2 nos. of base channel of size 100mm * 50mm for erecting transformer. Channel of size 75 * 40 mm for erecting D.O. fue set, L.A. , A.B. switch handle etc. Angle of size 50*50*6 mm for erecting Distribution box, Transformer belt, etc. as per drawing (App. 124 Kg. iron work )with necessary clamps, nut-bolts. Vee cross arm, top clip, insulators etc. complete with caution board & barbed wire. D.P. sytructure shall be erected in provided cc foundation.	1	Each	125024.00	125024.00
27	MSEDCL specification	Supplying & erecting 11 KV outdoor type Ring Main with scada cmpatible, motorised operation, without FRTU, Gas insulated & touch proof kit (if required), as per latest MSEDCL approval & speifications with following configuration complete on CC foundation/MS channels/trench, etc, in an approved manner.				0.00
	i	11KV 4nos. LBS + 1no. VCB	1	set	1150000.00	1150000.00
28	16.5.15	Supplying and erecting ISI mark G.I. pipe 100 mm dia 'C" class position with accessories. As per specification No. CW-PLB/GP or latest.	30	Mtr	1821.00	54630.00
29	8.4.26	Supplying & erecting end pole D.P.structure for 200kVA Transformer with R.S.J. Pole 2Nos. Of size 100 * 116 mm * 11 Mtr. Long with suitable distribution box of C.R.C.A. sheet 16 SWG (size 4 SqMtr.) with 4 pole MCCB 100 Amps kitkat for outing ckts. Transformer D.P.structure includes the A.B. switch 200 Amps. D.O. fuse set & L.A. set 2 Nos. top channel of size 100mm *50mm for erection of A.B. switch & 2 nos. of base channel of size 100mm * 50mm for erecting transformer. Channel of size 75 * 40 mm for erecting D.O. fue set, L.A. , A.B. switch handle etc. Angle of size 50*50*6 mm for erecting Distribution box, Transformer belt, etc. as per drawing (App. 124 Kg. iron work )with necessary clamps, nut-bolts. Vee cross arm, top clip, insulators etc. complete with caution board & barbed wire. D.P. sytructure shall be erected in provided cc foundation.	1	Each	131345.00	131345.00

30	MSEDCL specification	double circuit 4-pole structure for 33 kv termination				
	<b>i</b>	<b>SUPPORTS</b>				
	a)	RSJ 152x152, 13 m long	4	19101.32	No.	76405.28
	<b>ii</b>	<b>FIXTURES</b>				0.00
	a)	Clamps for 152 x 152 mm RSJ Pole Stay	40	229.10	PAIR	9164.00
	b)	HT earthing set	4	319.59	set	1278.36
	c)	HT stay set	7	543.66	set	3805.62
	d)	Stay Wire 7/8	61	55.00	Kg.	3355.00
	e)	cross arms clamps	16	229.10	Pair	3665.60
	f)	M.S. Nuts Bolts & U Bolts	51.2	73.00	Kg.	3737.60
	<b>iii</b>	Concreting ratio 1:3:6	10	4046.00	Cmt.	40460.00
	<b>iv</b>	<b>CONDUCTORS AND ACCESSORIES</b>				0.00
	a)	33 kV Pin Insulators with G.I. Pins	12	613.95	No.	7367.40
	b)	Disc Insulator 7000 KG.	6	200.75	No.	1204.50
	c)	M.S. Channel 100x50x6	948	47.05	Kg.	44603.40
	d)	M.S. Angle 50x50x6	274.4	47.05	Kg.	12910.52
	e)	M.S. Flat 50x10 mm (round clamp)	50	44.05	Kg.	2202.50
	f)	G.I. Pipe 200 mm	48	225.00	Mtr.	10800.00
	g)	Red Oxide Paint for 2 coats	4	56.00	Ltrs.	224.00
	h)	Aluminium Paint for 1 coat	4	96.80	Ltrs.	387.20
	<b>v</b>	Painting/Hardware & support with numbering of pole	4	220.00	L/S	880.00
	<b>vi</b>	P.G. Clamp	6	350.00	No.	2100.00
	<b>vii</b>	SUNDRIES	2	5000.00	L/S	10000.00
	<b>viii</b>	R.C.C. Pipe 150 mm 2 M	No	60.00	479.00	28740.00
	<b>ix</b>	RCC half round pipe (1mtr)	No.	900.00	86.00	77400.00
	<b>x</b>	Sand	Cmt	50.00	191.40	9570.00
	<b>xi</b>	Road resurfacing charges	Rmt	210.00	963.00	202230.00
		<b>Total</b>				<b>20897080.68</b>
		<b>Say</b>				<b>20897081.00</b>

**Note.**

- 1 I/We have seen by NIT Specifications.
- 2 I/We had gone through the detail specifications included in the tender & fully Conversant with the specifications laid down for concerned items along with IS Code.
- 3 I / We agree to carry out the work as per detail specifications.
- 4 I / We hereby tender for execution of work specified in **Schedule-B at ABOVE / BELOW / AT PAR** of the estimated Rates in Schedule of rates on the work to be carried.

**Contractor's Signature.**



## Annexure-III

### *ADDITIONAL SPECIFICATION / CONDITION*

- 1) Arrangement for the curing of C, C, foundation muffing, brick masonry work etc. shall be done by clean and soft water at site by the contractor at his own cost.
- 2) While executing the E.I. work, the agency shall provide Generator for Electrical Drill machine at his own cost.
- 3) The Agency shall follow the ISI specification, relevant standards, IER 1956 during the execution of work.
- 4) The agency shall obtain the permission of local Authority (N.O.C.) for digging the road if necessary.
- 5) If during the execution of work, shut down form M.S.E.D.C.L./ SPANCO. Side is necessary. In that case it is solely responsibility of agency to take necessary shut down with permission of local MSEDCL/SPENCO authority.
- 6) The agency will have to use necessary T&P while execution of work at his own cost.
- 7) After completion of work, the Agency shall have to carry necessary I R test and earth Test with calibrated meggar & earth tester and the test report of same shall be submitted.
- 8) The agency shall have to arrange the approval & inspection of E.I. from Electrical Inspector and accordingly N.O.C. shall be obtained however the necessary inspection fee will be borne by NMRCL. Also necessary testing charges of M.S.E.D.C.L./SPENCO shall be paid by the agency.
- 9) The work insurance and insurance of worker Labour insurance shall be done by agency under the insurance act of his own cost.
- 10) The complete responsibility of safety of worker during the execution of work is solely of agency. The agency will have to follow all the safety rules during the execution of work. If any accident occurred during the execution of work, the responsibility of compensation will be of agency. In any case, this NMRCL will not be responsible for any compensation.
- 11) Any fees/charges/taxes or penalties towards payment of Government/Semi-Government/Local /Private Bodies arising during the execution of the work is to be borne by the agency. No compensation or refunds will be paid for this.
- 12) Necessary approval for the material procurement shall be obtained by the contractor from the authority before starting the work.
- 13) The actual layout drawing shall be got approved by the contractor from the concern Electrical Inspector before starting the work.
- 14) The permission for charging the installation shall be obtained by the contractor from the concern Electrical Inspector after completion of the work.
- 15) The dismantled materials i.e. brackets clamps insulators, stay sets, A.B. switch Lightning Arrestors, G.I. Wire & ACSR conductors RSJ poles Transformer shall be

handed over to NMRL at Suitable Stores as directed by Engineer –in-charge and copy of receipt of handing over shall be submitted .This include lead and lift.

- 16) **Contractor has to take prior permission from MSEDCL/ SPANCO /NMC and any concerned authority for shifting of electrical services and it's shut down.**
- 17) The High Pot test of 11 KV cable shall be arrange by the agency at site after laying the cable in presence of the concerned Engineer of the NMRL . The cost will be borne by the agency.

## LIST OF APPROVED MAKES

1)	Armoured Cable (L.T.& H.T)	- Polycab, Gloster, CCI, Havells, KEI ,Vishal, RPG Ravin ,HMT (above all makes with ISI mark only) - 3M ,Rachem, RETL Compact, HMT - Zenith, Surya, Prakash
2)	HT termination Kit	
3)	GI Pipe	- Telerex, Electrex, REX
4)	D.W.C Pipe	- Kalki, CPL, KEW, Stanley
5)	T.P.N.	-Finolex, Polycab, Anchor, Cona, L&T, R.R. Cable, Havells, Standard
6)	Wire	
7)	MCCB	-H.P.L., Havells, L & T , Legrand, Siemens, Standard,  -Tata, Jindal with ISI mark
8)	R.S.J. Pole	-Kiran, Ruma Isolators, Adco ,
9)	G.O.D.	-Rumaisolators, Adco Crompton, Elpro,
10)	D. O.	- Lamco , Elpro
11)	Lighting Arrester	
12)	Load Break Swicth	-ABB, L&T, PCE, Magawin, crompton
13)	Ring Main Unit	-ABB, L&T , PCE, Magawin , crompton  -ABB , L& T , PCE, Magawin, crompton
14)	VCB (11 KV Breaker	-Crompton, patson, pactil, kirloskar ,High Rise.PVN , Bharat Transformer.
15)	Copper Transformer 315 KVA	

**Note :-**

- 1) All the above material to be used on the work shall posses the valid I.S. License or valid approval from the **Managing Director,NMRCL ,.Nagpur**
- 2) Makes other than specified in note (1) mention above will have to be got approved in written from the **Engineer –in- Charge, NMRCL .Nagpur** before its use on the work.

- 3) The Material brought at the site shall be ISI make And mark duly approved in written by Engineer –in- Charge of NMRCL
- 4) Samples of material during the execution of work will be collected and sent to testing if the testing results of material found unsatisfactory in that case the agency will have to replace the material free of

# NAGPUR METRO RAIL CORPORATION LIMITED

Name of Work:- Shifting of LT,HT O/H line ,crossings and providing LT,HT U/G cables from Lad square (CH:10750) to Munje Chowk (CH:7743) for Nagpur Metro Rail Project for E-Corridor.

## DETAILED SPECIFICATION

Sr. No. CSR Item No	Specification
1-4-2	The work shall be carried out as per wording of the item and as directed by Engineer in-charge.
1-4-3	The work shall be carried out as per wording of the item and as directed by Engineer in-charge
1-4-7	The work shall be carried out as per wording of the item and as directed by Engineer in-charge.
5-5-35.5	Moulded Case Circuit Breaker (MCCB)

### Scope

Specification No (SW-SWR/MCCB)

Providing & erecting 3 Pole/4 Pole MCCB of specified rating and with specified short circuit rupturing capacity in KA, complete erecting in provided enclosure & connected with provided leads on incoming and outgoing side, complete. General Specifications for MCCB's MCCB's should comply with IS 13947.part -2, IEC (6094) and IEC 60947-3 & IEC 60947 part2. The MCCB shall be suitable for universal mounting i.e. the load/line shall be interchangeable with shrouded incoming contacts.

The MCCB shall be suitable for minimum operating voltage of 415 V.

The thermal setting shall be adjustable from 64 % to 100% of  $i_{ns}$  normal current The magnetic setting shall be adjustable from 3.5 to 10 In (normal current).

Trip reset should be available Manual / Automatic.

Isolator switches for electronic circuits to open the MCCB automatically.

The MCCB\*s must house transparent label holder to ensure circuit identification. The MCCB's must have fully insulated safety shutters.

Overload Zone adjustable from 0.4 to 1 in with line (For 630 amp & above MCCB) Short circuit Zone adjustable from 1.5 to 10 In with time.

Material:

3 pole or 4 Pole MCCB Moulded case circuit breaker. Fixed version front Terminals with current rating & breaking capacity as below:

- i. 63 A to 125 A - 15 KA
- ii. 160 A to 250 A - 35 KA
- iii. 300/400 A - 35 KA
- iv. 630 A - 70 KA

**Method of Construction:**

3 pole /4 pole MCCB shall be erected in provided enclosure & connected with provided leads/strip on incoming & out going site complete

Mode of Measurement: Executed quantity shall be counted on number basis, (i.e. each)

5 5-10-10 The work shall be carried out as per wording of the item and as directed by Engineer n- charge.

6	5-10-24	The work shall be carried out as per wording of the item and as directed by
7	5-10-27	The work shall be carried out as per wording of the item and as directed by
8	6-1-2	The work shall be carried out as per wording of the item and as directed by
9	6-1-11	The work shall be carried out as per wording of the item and as directed by
10	6-1-16	The work shall be carried out as per wording of the item and as directed by
11	6-1-19	The work shall be carried out as per wording of the item and as directed by
12	6-1-20	The work shall be carried out as per wording of the item and as directed by
13	7-1 -21	Attached Separately
14	7-1-29	Attached Separately
15	7-3-12	Attached Separately"
16	7-5-1\$	7.4 & 7.5 Cable Joints & End Termination Kits (LT/HT Cables) (JT/LT/HT)

Specification No (CB-JT/LT/HT)

**1. Scope:**

Providing straight through cable jointing kit of approved make and jointing cable as per the manufacturer's instructions and duly marking name of jointer and date.

**2. Material:**

Joint kit: Kit manufactured by reputed manufacturer with PVC moulds made in two parts, with epoxy compound, earth continuity lead of appropriate cross section having lugs at both ends, aluminum ferrules of the size of the cable, cross shaped epoxy spacer, MS clips for holding the moulds, adhesive for pasting the moulds.

**3. Method of Construction:**

**Straight through joint Kit: LTVHT Cables**

Before providing joint to the cable, the cable ends of the equivalent length of the joint moulds, shall be prepared By removing the outer PVC insulation along with the steel armouring. The ferrule shall then be inserted over the bare core of the cable, and shall be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimped portion shall be wrapped first with the PVC insulation tape and then with the insulation tape used for wrapping HT conductor. The above method shall be carried out for all the cores strictly following the colour code. The leads of the both the cables now shall be placed into the mould by using the epoxy spacer<sub>s</sub> for having sufficient

gap in-between the leads. The earth continuity lead shall be clamped to the both ends of the cable. After covering the cable leads with the PVC moulds, the edges shall be clipped after applying the adhesive on the inside face of the moulds. The pasting of moulds shall be rigid and as far as possible leak proof, so that the epoxy compound shall not spill out. Now the duly stirred epoxy compound shall be poured and fill till the compound rises through the risers provided on the moulds.

After completing the above procedure," the joint shall be allowed to dry out for at least 8 to 10 hours (for epoxy compound to get hardened) depending upon the size of cable. Before connecting to supply, the dry and hardened joint shall be tested for its insulation level with 1000 V/ 5000 V Meggar.

The cable should be fixed or laid in such manner that there should not be pressure on end of moulds or on jointing position of cables. (Refer drawing No. CB-JT-1)

### **3.2 Outdoor/Indoor end termination Kit: LT/HT Cables**

Before providing end termination Id! to the cable, the cable end of the equivalent length of the moulds, shall be prepared by removing the outer PVC insulation along with the steel armouring. The ferrule shall then be inserted over the bare core of the cable, and shall be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimping shall be done in such a manner that there shall be no air gap. Then the crimped portion shall be wrapped first with the PVC insulation tape and then with the insulation tape used for wrapping HT conductor. The above method shall be carried out for all the cores strictly following the colour code. The leads of the cable now shall be placed into the mould by using the epoxy spacer, for having sufficient gap in-between the leads.

The earth continuity lead shall be clamped to intends of the cable. After covering the cable leads with the PVC moulds, the edges shall be clipped after applying the adhesive on the inside face of the moulds. The pasting of moulds shall be rigid and as far as possible leak proof, so that the epoxy compound shall not spill out Now the duly stirred epoxy compound shall be poured and fill till the compound rises through the risers provided on the moulds. (Refer drawing No. CB-JT-2)

After completing the above procedure, the joint shall be allowed to dry out for at least 8 to 10 hours (for epoxy compound to get hardened) depending upon the size of cable. Before connecting to supply, the dry and hardened joint shall be tested for its insulation level with 1000 V/ 5000 V Meggar. 4 Mode of Measurement:  
Executed quantity will be measured on number basis, (i.e. each).

7-6-5 The work shall be carried out as per wording of the item and as directed by Engineer in-charge.

7-6-4 4.1.1 Erection of Pipe on wall:

The required length of pipe shall be machine cut, without any sharp edges, burrs, etc. The pipe duly enclosing the specified material, shall be erected on wall in plum, and fixed with required size of MS clamps on wall with plugs, gitties, etc. When the pipe is to be fixed to walls it shall be fixed with standard bracket, clips or holder by keeping the pipe about 2mm clear of the wall. The pipe shall be fixed to the wall horizontally and vertically and parallel to one another, when more than one pipe is to be laid, unless unavoidable. The

supporting clips, etc. for the pipe shall be spaced at about two meters or so as necessary. Holes cut during construction shall not be left out; they shall be filled and finished after passing of the pipe through it.

#### 4.1.2 Erection- of Pipe on pole:

The required length of pipe shall be machine cut, without any sharp edges, burrs, etc. The pipe duly enclosing the specified material, shall be erected on pole in plum, and fixed with required size of MS clamps with MS nuts & bolts of required size and strength.

When the pipe is to be used as cable enclosure and is to be terminated on street light pole(s), the pipe at the trench level should be placed at least 30 cm above the cable level for avoiding damage to the insulation of cable.

#### 5-5-1 5.5 Moulded Case Circuit Breaker

(MCCB)(MCCB) Scope:

Specification No (SW-SWR/MCCB)

Providing & erecting 3 Pole/4 Pole MCCB of specified rating and with specified short circuit rupturing capacity in KA, complete erecting in provided enclosure & connected with provided leads on incoming and outgoing side, complete.

General Specifications for MCCB's

MCCB's should comply with IS 13947 part -2, IEC (6094) and IEC 60947-3 & IEC 60947 part 2. The MCCB shall be suitable for universal mounting i.e. the load/line shall be interchangeable with shrouded incoming contacts.

The MCCB shall be suitable for minimum operating voltage of 415 V.

The thermal setting shall be adjustable from 64 % to 100% of its normal current. The magnetic setting shall be adjustable from 3.5 to 10 In (normal current).

Trip reset should be available Manual / Automatic.

Isolator switches for electronic circuits to open the MCCB automatically.

The MCCB's must have transparent label holder to ensure circuit identification. The MCCB's must have fully insulated safety shutters.

Overload Zone adjustable from 0.4 to I in with line (For 630 amp & above MCCB) Short circuit Zone adjustable from 1.5 to 10 In with time.

*Material:*

3 pole or 4 Pole MCCB Moulded case circuit breaker. Fixed version front Terminals with current rating & breaking capacity as below:

i. 63 A to 125 A -

15 KA ii 160 A to 250 A

- 35 KA iii.300/400 A

-

35 KA

iv.630A - 70 KA

*Method of Construction:*

3 pole /4 pole MCCB shall be erected in provided enclosure & connected with provided leads/strip on incoming & out going site complete

Mode of Measurement: Executed quantity shall be counted on number basis, (i.e. each)

20 8-1-10 Attached Separately

21 8-1-11 Attached Separately

22 8-4-1 Attached Separately

23 8-4-2 Attached Separately'



- 24 8-4-11 Attached Separately  
 25 8-4-12 B)D Vee Cross ArmD(OH-PL/VCA)

*G Scope:*

Specification No D(OH-PL/VCA)1a  
 Supplying Vee cross arm, suitable for 11 kV and necessary ancillary materials  
 complete erection on provided pole with necessary painting as per specification and as per the  
 instructions from the site engineer,

**Material:**

- a) Cross arm: Channel Iron cross arm
- b) Hardware: G.I. nut bolts
- c) Flat: MS flat 80 x 10 mm thick
- d) Clamp; Two clamps made from MS flat of size 80 x10 mm.
- e) Paint: Red oxide. Silver paint.

*Method of construction:*

Fabricating the Vee cross arm for erecting Insulators with channel 75 x 40 mm with the 4.4 mm thick web and 7.3 mm thick flange, length of 45 mm for base of insulator, vertical member of suitable

length to maintain the clearance of 1220 mm, will angle of 60<sup>0</sup> degrees to horizontal and M.S. flat of 80 x 10 mm at centre of cross arm fixed to the pole by means of two <sup>A</sup> clamps of 80 x 10 mm. M.S. flat with 15mm. dia bolts and nuts Q duly painted with one coat of red oxide paint and two coa of aluminum paint. Cross arm same all be fabricated as per drawing no. OH-PL/BKT-I (Fig.1) Ci Detailed specifications of material of the items included in CSR are given in OTable No8.4/2.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. Deach)

- 26 **8-4-14** B) Vee Cross Arm OO(OH-PI7VCA)

*Scope:*

Specification No D(OH-PL/VCA1)0  
 Supplying Vee cross arm, suitable for 11 kV and necessary ancillary materials  
 Incomplete Defection on provided pole with necessary painting as per  
 specification and as per Destructions from the site engineer. D Material:

Cross arm: Channel Iron cross arm  
 Hardware: G.I. nut bolts DFlat: MS flat 80 x 10 mm  
 thick Clamp: Two clamps made from MS flat of  
 size 80 x10mm.

*Paint: Red oxide. Silver paint.*

*Method of construction:* Fabricating the Vee cross arm for .erecting  
 Insulators with channel 75 x 40 mm with 4.4 mm thick web and 7.3 mm  
 thick flange, length of 45 mm for base of insulator, vertical member of  
 suitable length to maintain the clearance of 1220 mm, will angle of 60  
 degrees to horizontal and

M.S. flat of 80 x JO mm at centre of cross arm fixed to the pole by means  
 of two A clamps of 80 x 10 mm M.S. flat with 15mm. dia bolts and nuts  
 duly painted with one coat of red oxide paint and two coa of aluminium  
 paint. Cross arm shall be fabricated as per drawing no. OH-PL/BKT-I ( Fig.  
 1)

Detailed specifications of material of the items included in CSR are given  
 in Table No 8.4/2. Mode of Measurement: Executed quantity will be  
 measured on number basis (i.e. each)

- 27 **8-4-15** B) Vee Cross Arm a (OH-PITVCA)

*Scope:*

Specification No D(OH-PL/VCA1)D

Supplying Vee cross arm, suitable ;"or 11 kV a<sup>A</sup>d necessary ancillary materials complete Direction on provided pole with necessary painting as per specification and as per Destructions from the site engineer.

*Material:*

Cross arm: Channel Iron cross arm

Hardware: G.I. nut bolts Q Flat: MS flat 80 x 10 mm thick

Clamp : Two clamps made from MS flat of size 80

x10mm. Paint: Red oxide. Silver paint.

*Method of construction:*

Fabricating the Vee cross arm for erecting Insulators with channel 75 x 40 mm with 4.4 mm thick web and 7.3 mm thick flange, length of 45 mm for base of insulator, G vertical member of suitable length to maintain the clearance of 1220 mm, with angle of 60 D degrees to horizontal and M.S. fiat of 80 x 10 mm at centre of cross arm fixed to the pole by means of two A clamps of 80 x 10 mm M.S. flat with 15mm. dia bolts and nuts duly painted with one coat of red oxide paint and two coat of aluminium paint. Cross arm shall be fabricated as per drawing no. OH-PL/BK.T-I

Detailed specifications of material of the items included in CSR are given in Table No 8.4/2.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

28 8-5-2 8.5 Conductors (CON)

A) All Aluminium Conductors

(AAC)(OH- CON/AAC)

■ Scope:

■ Specification No {OH-C ON/AAC)

■ Supply and erection of All Aluminium Conductors for overhead line.

■Material:

■Conductor: All aluminium stranded conductor . (As

per table

8.5/1)

■

■Binding wire: 12 SWG aluminium binding wire.

■Clamps: PG clamps as per requirement

*Method of construction:*

At first the conductor is removed from bundle/drum straighten without knots, bends, etc. Stringing of conductor shall be done with draw vice. Conductor shall not be twisted while stringing. Shackle insulators sr be used if the line deviates by 30 degrees or more, at terminal pole and at junction/ cut pole.

Parallel double groove clamp having two nut bolts designated to carry full line current shall be used for making Jumper w connections.

On straight line the conductor shall be bounded on top groove of insulator and at angular position binding shall be done in side groove. Binding wire of 12 SWG shall be of the same metal as that of conductor.

Mode of Measurement:

For measurement purpose, sum of the total conductor including jumper connections shall be considered, (i.e. per km)

29 8-5-5 8.5 Conductor (CON)

A)AI1 Aluminum Conductors (AAC)(OH-CON/AAC)

**Scope:**

Specification No (OH-CON/AAC)

Supply and erection of All Aluminum Conductors for overhead line. Material:

Conductor: All aluminum stranded conductor (As per table 8.5/1) (Binding wire: 12 SWG aluminum binding wire

Clamps: PG clamps as per requirement Method of construction:

At first the conductor is removed from bundle/drum straighten without knots, bends, etc. Stringing of conductor shall be done with draw vice. Conductor shall not be twisted while stringing.

Shackle insulators shall be used if the line deviates by 30 degrees or more, at terminal pole and at junction/ cut pole.

Parallel double groove clamp having two nut bolts designated to carry full line current D shall be used for making Jumper connections.

On straight line the conductor shall be bounded on top groove of insulator and at angular position binding shall be done in side groove. Binding wire of 12 SWG shall be of the same metal as that of conductor. Mode of Measurement:

**For measurement purpose, sum of the total conductor including jumper connections D shall be considered, (i.e. per km)**

30 8-5-10 Attached Separately

31 8-5-12 The work shall be carried out as per wording of the item and as directed by Engineer in-charge. Shall be carried out as per wording the

32 8-6-3 item and as directed by Engineer in-charge. 5.5 Molded Case Circuit

33 5-5-2 Breaker (MCCB) (MCCB)

**Scope:**

Specification No (SW-SWR/MCCS)

Providing & erecting 3 Pole/4 Pole MCCB of specified rating and with specified short circuit rupturing capacity in KA, complete erecting in provided enclosure & connected with provided leads on incoming and outgoing side, complete. General Specifications for MCCB's MCCB's should comply with IS 1 3947 part -2, IEC (6094) and IEC 60947-3 & IEC 60947part 2. The MCCB shall be suitable for universal mounting i.e. the load/line shall be interchangeable with shrouded incoming contacts.

"The MCCB shall be suitable for minimum operating voltage of 415V. The thermal setting shall be adjustable from 64 %to 100% of its normal current. The magnetic setting shall be adjustable from 3.3 to 10 In (normal current). Trip reset should be available Manual / Automatic. Isolator switches for electronic circuits to open the MCCB automatically. The MCCB's must house transparent label holder to ensure circuit identification.

The MCCB's must have fully insulated safety shutters. Overload Zone adjustable from 0.4 to 1 in with line (For 630 amps & above MCCB) Short circuit Zone adjustable from 1.5 to 10 In with time.

**Material:**

3 pole or 4 Pole MCCB Molded case circuit breaker. Fixed version front Terminals with current rating & breaking capacity as below:

i. 63 A to 125 A -

15KA ii 160 A to 250 A

35 KA

iii 300/400 A - 35 KA

iv. 630 A - 70 KA

**Method of Construction:**

3 pole /4 pole MCCB shall be erected in provided enclosure & connected with provided leads/strip on incoming & out going site complete Mode of Measurement: Executed quantity shall be counted on number basis, (i.e. each)

34 8-6-6 8.6 Insulators (INS)

A) Porcelain Disc Type Insulator 11/22/33 kV DO(OH-INS/DI)

**Scope**

Specification No (OH-INS/DI)

Supplying porcelain disc type insulator, suitable for 11/22/33KV and necessary Q ancillary materials and complete erection provided cross arm / bracket and connected to the over-head line as per instructions from the site engineer

**Material:**

Insulator: Distribution class Disc type insulator made from porcelain, suitable for specified voltage level, having 1Smark with necessary hardware. Hardware; Nuts, washers, etc.

Binding wire: Bare Copper wire or conductor. C-lamps: MS clamps.

**Method of construction:**

Distribution class porcelain disc type insulator, suitable for specified voltage level, erected on provided cross arm or Bracket with clamps, ancillary materials, and connected to the over-head line. Connection shall be made with bare copper wire of specified gauge.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. each) 8-6-9

B) PinType Insulator 11/22/33 kV(OH-INS/PN)

**Scope:**

Specification No (OH-INS/PN)

Supplying porcelain Pin type insulator, suitable for 11/22/33KV and necessary ancillary materials and complete erection . Provided cross arm / bracket and D connected to the over-

head line as per instructions from the site engineer Material: insulator: Distribution class Pin type insulator made from porcelain, suitable for d specified voltage level, having ISI mark, with necessary hardware. Hard ware: Nuts, washers, etc. Binding wire: Bare Copper wire or conductor. lamps: MS clamps.

**Method of construction;**

Distribution class porcelain pin type insulator suitable for specified voltage level, a erected on provided cross arm or bracket with clamps, ancillary materials, and D connected to the over-head line. Connection shall be made with bare copper wire of specified gauge. Mode of Measurement: Executed quantity will be measured on number basis (i.e. each)

**Thyrite type Lightning Arrester 11/22 kV (OH-**

**INS/LA) Scope:**

**Specification No (OH-INS/LA)**

Supplying porcelain Thy rite type lightning arrester, suitable for specified voltage level and necessary ancillary materials and complete erection on provided cross arm / bracket and connected to the over-head line as per instructions from the engineer.

Material:

Arrester: Distribution class Thy rite type lightning arrester made from porcelain, suitable for specified voltage level, have ISI mark.

**Hardware:** Nuts, washers, etc. Binding wire: Bare Copper wire or conductor. Clamps: MS clamps.

**Method of construction:**

Distribution class porcelain Thy rite type lightning arrester, suitable for specified voltage level, erected on provided cross arm or bracket with clamps, ancillary materials, and connected to the over-head line. Connection shall be made with bare copper wire of specified gauge.

Mode of Measurement: Executed quantity will be measured on number basis (i.e. D each) The work shall be carried out as per wording of the item and as directed by Engineer in- charge. The work shall be carried out as per wording of the item and as directed by Engineer in-charge. The work shall be carried out as per wording of the item and as directed by Engineer in-charge. The work shall be carried out as per wording of the item and is directed by Engineer in-charge. The work shall be carried out as per wording of the item and as directed by Engineer in-charge. The work shall be carried out as per wording of the item and as directed by Engineer in-charge.

- J4 8-8-2 The work shall be carried out as per wording of the item and as directed
- 45 8-8-4 The work shall' be carried out as per wording of the item and as directed
- 46 8-8-3 The work shall be carried out as per wording of the item and as directed  
by Engineer in-charge.
- 48 9-1-1 Attached Separatey
- 9-1-5 B) Low Impedance Earthing (Pipe in pipe technology)D(EA-EPP)

**Scope;**

Specification No D(EA-EPP)

Supplying -and erecting approved type earthing system with Pipe in pipe technology with necessary ancillary materials and complete erection as per instructions from the site engineer

**Material:**

GI Pipe: As per specification no. (CW-PLB/GP) mentioned chapter 17.5;

1. 50 mm dia x 3 meter long (In plate of traditional GI pipe Earthing), for LV /MV applications.

2. 80 mm x 3 meter Song (In place of traditional copper plate Earthing), for HV/EHV applications. Earthing Conductor: G.I strip/GI earth wire of size as per specifications given in

Table No 9.1/1. GI Pipe: As per specification no. (CW-PLB/GP) mentioned chapter 17.5 for watering and as enclosure for Earth wire, as per specifications given in Table No 9.17V

Hardware: Screw/ nut bolts with required washer of dimensions, Rawl plug/clip/ U\* Nails and material as per specifications given in Table No 9.

Filling material: Coal /Charcoal/ salt as per specifications given in Table No

9.1/1. as per specifications given in Table No 9,7/7.

Lugs: As per specification no. (CB-LG/AL, CB-LG/CU) mentioned in chapter 7.9& 7.10 for Copper/ Aluminium lugs and as per specifications given in Table No 9.1/1.

**Method of construction:**

Earthing Pipe in pipe technology with ancillary materials shall be done by digging an 8" / 10" dia. hand bore 10.5' deep sufficient to install the electrode in normal soil conditions. The space between the soil and the electrode is filled up with electrolyte material mixed with the dugout mother soil, along with water and tightly packed up to the base of the terminal. In rocky areas and under hard soil and sandy soil conditions the method of installation will be as specified by manufacturer. Installation shall include drilling, welding, reverting, brazing and nut bolting pipe when ever required in an approved manner with required material such as nut bolts and washer etc. .and with necessary brick masonry work as per the specification. (As per IS 3043 amended up to-date). As far as possible continuous GI strip shall be used but when ever jointing of strip is un avoidable, the jointing over lap portion must not be less than 21/2 times the width of the strip either welded/ brazed/soldered by all sides or overlap of 6 inch with two nut bolts/ riveting of adequate size with required washer and covered by anti corrosive paint as per approved jointing practice in the industry and as per directives from site engineer in-charge.

**Testing:**

The value of each earth electrode shall be measured by earth tester and record to be submitted. (Also refer drawing No.2)

Mode of Measurement: Executed quantity will be measured on number basis i.e. each

49 9-2-1 Attached Separately

50 9-2-5 The work shall be carried out as per wording of the item and as directed

51 10-1- The work shall be carried out as per wording of the item and as directed

52 10-2- The work shall be carried out as per wording of the item and as directed

53 10-2- The work shall be carried out as per wording of the item and as directed

54 10-2- The work shall be carried out as per wording of the item and as directed

55 10-3- The work shall be carried out as per wording of the item and as directed

56 10-3- The work shall be carried out as per wording of the item and as directed

57 16-1- Attached Separately

58 16-3- The work shall be carried out as per wording of the item and as directed

- 59 16-3- The work shall be carried out as per wording of the item and as directed  
60 16-3- The work shall be carried out as per wording of the item and as directed

## Chapter 7

## PVC/XLPE ...Cables (CB)

### 7.1, 7.2, a 7.3 Armoured Cables (HT & LT)

#### 1. General

All material shall conform to relevant standard as per BIS and shall carry ISI particular category of material for which ISI mark is not available in market, It included in approved list.

Work shall be carried out as per the method of construction specified by BIS. if there is no reference for particular method of construction in IS, such work shall be carried out as per the approved method of construction specified in chapter 15 of P.W. Dept. Handbook.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

#### 2. Cables: (Armoured)

The following list records those Indian Standards in force, which are acceptable as good practice, and accepted standards.

SP 30: 1984 : National Electrical

Code SP 7 (Group 4): 2005 : National Building

Code

IS 1255; 1983 : Code of practice of Installation & Maintenance of armoured cables up to 33 kV.

IS 3961: Part 2: 1967 : Recommended current ratings of PVC cables.

IS 1554: Part 1; 1983 :PVC insulate  
(Heavy duty) Electric Cables; Part 1for  
working voltages up to and including 1100  
Volts

IS 1554: Part 2: 1988 : PVC Insulated (Heavy duty) Electric Cables; Part 1  
for working voltages up to and including 3.ri kV to 11  
kV,  
IS 10810: Part 63; 1993 : Method for Test of cables, Part 63 Smoke density  
of electric cables under fire condition

### 3. Scope; (Armoured cables)

#### Specification No, (CB-LT/AL, CB-LT/CU, CB-HT)

Providing armoured cable of specified voltage level, size & specified conducting material Aluminum / Copper) as per Table no, 7/3 including required material, hardware's for erection and erecting on wall, ceiling, RCC slab or drawing the same through pole, pipe, laying in provided conduit, trench, ducts, trays as per approved method of construction including glands, lugs, etc.

#### 4.Material:

**Cables:** Cables shall be PVC for LT/MP and XLPE for HT as per Table no. 7/3 and of required construction, colour, shall<sup>1</sup> carry ISI mark, IS No, manufacturer's name, size, duly embossed / screen printed at every meter and having the total count of progressive length in meter at each mark.

**Earth wire:** Galvanized Iron (G!) wire of appropriate gauge as per Table No 7/1. **Glands:** As per specification (C'B-GL) **Lugs:** As per specification (CB-CL/AL, CB-CL/CU)

**Saddles:** Saddles fabricated, from G! Sheet of required gauge and size depending on die of cable either galvanized or painted with superior quality name! Black paint with necessary shearing mechanical strength, semi circular shaped with extended piece having suitable holes for fixing. **G I Strip:** 22 q x 25 mm width G I Strip.

**Clamps:** MS Clamps fabricated of required length and shape, having the size of 3/6 mm • thick mild steel "having 25/50 mm width (as per size of cable), rounded ends with wooden / resin cast-grip for holding the cable.

**Identification tags:** For identifying root, connection position G! strip with identification. Mark / name embossed / painted 'with arrangement to tie should be fix on cable or arrangement of ferrules to be done.



*Hardware:* Sheet Metal (tfo) screws of required sizes, plugs / wooden gutties, etc.

#### **4. Method of Construction;**

Irrespective of method of construction the cable ends shall be terminated with appropriate size & type of glands with lugs duly crimped, as directed by Site engineer.

Wherever the cable has to be bent, the turning radius shall be as mentioned in Table No 7/2. Grouping of cables shall be done with adequate distance between cables as mentioned in IS so as to minimize the jointing. Cables shall be tagged/ferruled with identification name / mark at the point from where distribution starts and at ends. Bar earth wire of appropriate size As per Table- r-o. 7/1 shall run along with the .cable. Earth wire running with the cable shall be terminated at the earth terminal nearest to. Cable termination.

##### **5.1 Erection of Cable on Surface:**

Erection shall be done as per the routes and layout finalized, in perfect level and in plumb. Before fixing the cable shall be straightened as far as possible for good aesthetics look, continuous bare GI earth wire of required gauge as per Table No 7/1 shall be run. Cable with G I wire shall be fixed by saddles firmly clipped on cable and shall be fixed to wall, with minimum 50 x 8 mm SM screws with plugs/wooden gutties, etc. {Distance between two supports / saddles shall be maximum 450 mm}. Wooden gutties shall be used wherever required (especially for stone wall}. The entries made in wall, floor slab, etc for laying trie. Cable shall be made good by filling and finishing with plastering the same.

##### **5.2 Erection of Cable on Trusses:**

Cable along with bare GI earth wire, while erecting on trusses, shall be firmly clamped by wrapping GI strip of 22\_g, 25 mm width of required length fixed to truss with nuts and bolts.

##### **5.3 Erection of Cable on Pole:**

Cable along with bare GI earth wire, while erecting on pole, shall be firmly clipped by suitable wooden / epoxy resin cast grips, clamped with 25 x 3 mm or 50x6 mm MS strip of required length and fixed to pole with nuts and bolts.

##### **5.4 Laying of Cable in provided Trench/Pole:**

While laying Cable along with bare G! Earth wire, utmost care shall be taken to prevent damage to the insulation of the cable and to the open end. Cable shall be brought out from trench vertically straight (minimum 1, 0 meter above G L). Care shall be taken to inspect the trench so that depth of cable shall not be less than as shown in Table No 7/4. Suitable size of cable loops shall be provided near termination point at adequate depth.

##### **5.5 Erecting cable in constructed Trench / duct:**

Erection of cable/s in constructed trench / duct, shall be as per guide lines of IS 1255.

**5.6 Erection of cable/3 on trays:**

Cable/s shall be tied with PVC tags on GI trays. At bending point care shall be taken so that sharp edges of sheet will not damage insulation of cable.

**5.7 Mode of JVe measurement:**

Executed quantity shall be measured on the basis of running meter per run of cable.

**6. Dismantling**

Cable laid underground, or fixed on any surface shall be dismantled carefully without damaging complete with all its accessories, making coil and stored as directed. The surface of the dismantled cable shall be made clear by removing of unwanted material, cement mortar, etc. When cable is dismantled from trench refill back the trench and making the surface proper.

**7. Mode of Measurement:**

Executed quantity shall be measured on the basis of running meter per run of cable.

**TABLE NO 7/1**

**Size of J Bare GI Earth wire to be. used with LT Cables up to 1.1 kV**

<b>S. No.</b>	<b>Size of cable</b>	<b>Size of bare GI Earth wire used with cable</b>
<b>1</b>	2.5 Sq mm to 50 Sq mm of all cores.	12SWG
<b>2</b>	70 Sq mm to 95 Sq mm of all cores.	10SWG
<b>3</b>	120 Sq mm and above of all cores.	8 SWG

**C) Rolled Steel Joist (RSJ) Poles(OH-PL/RSJ)**

**Scope:**

**Specification No:(OH-PL/RSJ)**

Supply and erection of Roiled Steel Joist (Girder) pole as per IS 2713, including in provided foundation as per method of construction. **Material:**

Pole: Rolled Steel Joist (Girder) As per Table No 3.1/2 **Base plate:** MS Base plate of 30x30x0.6 cms.

**Hardware:** Nut and bolts for fixing earth wire

**Paint:** Bituminous paint, Aluminum paint, Red oxide paint.

**Method of Construction:**

Before erection of pole base plate of size 30x30x0.6 cm shall be full length welded, at the bottom of pole, a suitable hole of required diameter and at specified height shall be drilled for earth stilled. The pole shall be then painted by 2 coats of red oxide paint as primer for full length and then by one coat of bituminous paint before erection for min,1/6 length which is to be buried in ground & after erection remaining portion-to be painted by two coats of aluminum paint. The pole shall be erected in provided pit with cement concrete foundation and muffing in perfect plumb. {As per drawing)

**Mode of Measurement:**

Executed quantity will be measured on number basis, (i.e. each)

Table No. 3.1/2

**Weight of various sizes of RSJ Poles with 8.5 meter length**

<b>RSJ POLE</b>	<b>Size</b>	<b>Weight per Meter</b>
Rolled steel Joist	150x80 /150x75mm	14.9 Kg/meter
Rolled steel Joist	200x100 mm	25.4 Kg/meter
Rolled steel Joist	175x90 mm	19.3 Kg/meter
Rolled steel Joist	100x116 mm	23.0 Kg/meter
Rolled steel Joist	125x75 mm	12.42 Kg/meter
Rolled steel Joist	152x152 mm	37.0 Kg/meter

**Rail Poles(OHPL/RLP) Scope;**

**Specification No (OH-PL/RLP)**

Supply and erection of Rail. Pole including painting in provided foundation **as per** method of construction. **Material**

**Pole:** Rail Pole 29.76 Kg/ meter, as per IS 2713 (Part II)

**Base plate:** MS Base plate of 30x30x0.6 cms.

**Hardware:** Nut and bolts for fixing earth wire

**Paint:** Bituminous paint, Aluminum paint. Red oxide paint.

Before erection of pole, base plate of size 30x30x0.6 cm shall be full length welded or fixed with

4 set screws at the bottom of pole, a suitable hole of required diameter and at 'specified height shall be drilled for earth stud. The pole shall be then painted by 2 coats of Ted oxide paint as primer for full length and then by one coat of bituminous paint before erection for 1/6 length which is to be buried in ground & after, erection remaining portion is to be painted by two coats of aluminum paint The pole shall be erected in provided pit with cement concrete foundation and muffing in perfect plumb.

**Mode of Measurement:**

Executed quantity will be measured on number basis, (i.e. each)

**5.5 Moulded Case Circuit Breaker (MCCB) (MCCB)**

**Scope:**

**Specification No( SW-SWR/MCCB)**

Providing & erecting 3 Pole/4 Pole MCCB of specified rating and with specified short circuit rupturing capacity in KA, complete erecting in provided enclosure & connected with provided leads on incoming and outgoing side, complete.

**General Specifications for MCCB's**

- MCCB's should comply with IS 13947 part -2, IEC (6094) and IEC 60947-3 & IEC 60947 part - 2.
- The MCCB shall be suitable for universal mounting i.e. the load/line shall be interchangeable with shrouded incoming contacts.
- The MCCB shall be suitable for minimum operating voltage of 415V.
- The thermal setting shall be adjustable from 64 % to 100% of its normal current.
- The magnetic setting shall be adjustable from 3.5 to 10 In (normal current).
- Trip reset should be available Manual / Automatic.
- Isolator switches for electronic circuits to open the MCCB automatically.
- The MCCB's must house transparent label holder to ensure circuit identification.
- The MCCB's must have fully insulated safety shutters.
- Overload Zone adjustable from 0.4 to 1 in with line (For 630 amp & above MCCB)
- Short circuit Zone adjustable from 1.5 to 10 In with time.

**Material:**

3 pole or 4 Pole MCCB Moulded case circuit breaker. Fixed version- front Terminals with current rating & breaking capacity as below:

- |      |                |   |       |
|------|----------------|---|-------|
| i.   | 63 A to 125 A  | - | 15 KA |
| ii.  | 160 A to 250 A | - | 35 KA |
| iii. | 300/400 A      | - | 35 KA |
| iv.  | 630 A          | - | 70 KA |

**Method of Construction:**

3 pole /4 pole MCCB shall be erected in provided enclosure & connected with provided leads/strip on incoming & out going site complete

**Mode of Measurement:** Executed quantity shall be counted on number basis. (i.e. each)

## Chapter 7 **PVC/XLPE Cables (CB)**

### **7.1, 7.2, & 7.3 Armoured Cables (HT & LT)**

#### **General**

All material shall conform to relevant standard as per BIS and shall carry ISI mark. If any particular category of material for which ISI mark is not available in market, it shall be as included in approved list.

Work shall be carried out as per the method of construction specified by BIS. If there is no reference for particular method of construction in IS, such work shall be carried out as per the approved method of construction specified in chapter 16 of P.W. Dept. Handbook.

Material and Work not qualifying to any provision mentioned above shall be to the satisfaction of the Engineer in Charge.

#### **Cables:** (Armoured)

The following list records those Indian Standards in force, which are acceptable as good practice, and accepted standards.

SP 30: 1984 : National Electrical Code SP 7 (Group 4): 2005 : National Building Code

IS 1255: 1983 Code of practice of Installation & Maintenance of armoured cables up to 33 kV.

IS 3961: Part 2: 1967: Recommended current ratings of PVC cables. IS 1554: Part 1; 1988 : PVC Insulated (Heavy duty) Electric Cables; Part 1 for working voltages up to and including 1100 Volts.

IS 1554: Part 2; 1988: PVC Insulated (Heavy duty) Electric Cables; Part 1 for working Voltage up to and including 3.3 kV to 11k V .

IS 10810: Part 63; 1993 : Method for Test of cables, Part 63 Smoke density of electric cables under fire condition.

Scope: (**Armoured** cables)

#### **Specification No. (CB-LT/AL, CB-LT/CU, CB-HT)**

Providing armoured cable of specified voltage level, size & specified conducting material (Aluminum / Copper) as per **Table no. 7/3** including required material, hardware's for erection and erecting on wall, ceiling, RCC slab or drawing the same through pole, pipe, laying in

provided conduit, trench, ducts, trays as per approved method of construction including glands, lugs, etc.

**Material:**

**Cables:**

Cables shall be PVC for LT/MP and XLPE for HT as per Table no. 7/3 and of required construction, colour, shall carry ISI mark, IS No, manufacturer's name, size, duly embossed / screen printed at every meter and having the total count of progressive length in meter at each mark.

**Earth wire:** Galvanized Iron (G I) wire of appropriate gauge as per Table No 7/1.

**Glands:** As per specification **(CB-GL)**

**Lugs:** As per specification **(CB-CL/AL, CB-CL/CU)**

**Saddles:** Saddles fabricated from GI sheet of required gauge and size depending on dia of cable either galvanized or painted with superior quality enamel black paint with necessary shearing mechanical strength, semi circular shaped with extended piece having suitable holes for fixing.

**G I Strip:** 22 g x 25 mm width G I Strip.

**Clamps:** MS Clamps fabricated of required length and shape, having the size of 3/6 mm thick mild steel having 25/50 mm width (as per size of cable), rounded ends with wooden / resin cast grip for holding the cable.

**Identification tags:** For identifying root, connection position GI strip with identification mark / name embossed / painted with arrangement to tie should be fix on cable or arrangement of ferrules to be done.

**Hardware:** Sheet Metal (SM) screws of required sizes, plugs / wooden gutties, etc.

**7.4 & 7.5 Cable Joints & End Termination Kits**

**(LT/HT Cables) (JT/LT/HT)**

**1 .Scope:**

**Specification No (CB-JT/LT/HT)**

Providing straight through cable jointing kit of approved make and jointing cable as per the manufacturer's instructions and duly marking name of jointer and date.

**2. Material:**

**Joint kit:** Kit manufactured by reputed manufacturer with PVC moulds made in two parts, with epoxy compound, earth continuity lead of appropriate cross section having lugs at both ends, aluminum ferrules of the size of the cable, cross shaped epoxy spacer, MS clips for holding the moulds, adhesive for pasting the moulds.

**3. Method of Construction:**

**3.1 Straight through joint Kit: LT/HT Cables**

Before providing joint to the cable, the cable ends of the equivalent length of the joint

moulds, shall be prepared by removing the outer PVC insulation along with the steel armouring. The ferrule shall then be inserted over the bare core of the cable, and shall be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimped portion shall be wrapped first with the PVC insulation tape and then with the insulation tape used for wrapping HT conductor. The above method shall be carried out for all the cores strictly following the colour code. The leads of the both the cables now shall be placed into the mould by using the epoxy spacer, for having sufficient gap in-between the leads. The earth continuity lead shall be clamped to the both ends of the cable. After covering the cable leads with the PVC moulds, the edges shall be clipped after applying the adhesive on the inside face of the moulds. The pasting of moulds shall be rigid and as far as possible leak proof, so that the epoxy compound shall not spill out. Now the duly stirred epoxy compound shall be poured and fill till the compound rises through the risers provided on the moulds.

After completing the above procedure, the joint shall be allowed to dry out for at least 8 to 10 hours (for epoxy compound to get hardened) depending upon the size of cable. Before connecting to supply, the dry and hardened joint shall be tested for its insulation level with 1000 V/ 5000 V Meggar.

The cable should be fixed or laid in such manner that there should not be pressure on end of moulds or on jointing position of cables. (Refer drawing No. CB-JT-1)

### **3.2 Outdoor/Indoor end termination Kit: LT/HT Cables**

Before providing end termination kit to the cable, the cable end of the equivalent length of the moulds, shall be prepared by removing the outer PVC insulation along with the steel armouring. The ferrule shall then be inserted over the bare core of the cable, and shall be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimping shall be done in such a manner that there shall be no air gap. Then the crimped portion shall be wrapped first with the PVC insulation tape and then with the insulation tape used for wrapping HT conductor. The above method shall be carried out for all the cores strictly following the colour code. The leads of the cable now shall be placed into the mould by using the epoxy spacer, for having sufficient gap in-between the leads. The earth continuity lead shall be clamped to the ends of the cable. After covering the cable leads with the PVC moulds, the edges shall be clipped after applying the adhesive on the inside face of the moulds. The pasting of moulds shall be rigid and as far as possible leak proof, so that the epoxy compound shall not spill out. Now the duly stirred epoxy compound shall be poured and fill till the compound rises through the risers provided on the moulds. (Refer drawing No. CB-JT-2) After completing the above procedure, the joint shall be allowed to dry out for at least 8 to 10 hours (for epoxy compound to get hardened) depending upon the size of cable. Before connecting to supply, the dry and hardened joint shall be tested for its insulation level with 1000 V/ 5000 V Meggar

4 *Mode of Measurement:*

Executed quantity will be measured on number basis. (i.e. each).

## 7.7 Cable Glands (GL)

### Scope:

### Specification Nos. (CB-GL)

Termination of cable ends with cable glands for preparing and fixing the cable leads for connection. Cable glands shall be of Flange type.

### Material:

**Cable glands:** Flange type heavy duty. Made of high purity brass metal, with brass washers, rubber rings, threaded stud with washers and nuts.

### Method of Construction

Before erection of gland, the cable end shall be prepared by removing the outer PVC insulation up to the point where gland to be fixed, by assessing the length of leads required. Bottom portion of gland shall be inserted over the steel armouring, and then armour strips shall be bent for the length of collar of gland, remaining length of armouring shall be cut. The cable end shall then be, inserted through the entry of plate where the cable is to be terminated. The top portion of gland with washer shall be then inserted in such a manner that the bent armour strip should be touching the surface of the entry. The nuts shall be tightened with spring washers over the projected stud portion. Fixing of gland shall be at right angle to the gland plate. Tightening shall assure continuity of earth. Hole to the gland plate shall be punched / knocked out, of correct diameter with respect to gland size.

### Mode of Measurement:

Executed quantity will be measured on number basis. (i.e. each)

## 7.9 & 7.10 Cable Lugs (Aluminum & Copper)

2.

### Scope:

### Specification Nos. (CB-CL/AL, CB-CL/CU)

Crimping of lugs, and fixing to the terminals with nuts and bolts, etc.

3.

### Material:

**Lug:** Lug shall be of high purity aluminum / copper / bimetallic of required type, with required size of hole and smooth finished both from inside and outside. **Hardware:** Brass or Cadmium plated mild steel nuts and bolts, bimetallic washers. **Anti-Oxide paste:** Paste of superior quality manufactured by reputed manufacturer.

4.

### Method of Construction:



Before fixing of lugs to the cable end, the cable end to the equivalent length of the lug shall be prepared by removing the outer PVC insulation along with the steel armouring and then, the inner PVC insulation. The paste shall be applied to the cable lead and inside the lug prior to the inserting of lug on the cable lead. The lug shall then be crimped with hydraulic / mechanical type heavy duty crimping tool. The crimping shall be done in such a manner that there shall be no air gap. Then the crimped portion shall be wrapped with the PVC insulation tape. (Colour of tape shall be of that of cable lead) The above method shall be carried out for all the cores. The cable end with lug shall then be terminated into the terminal and then be tightened with either brass nuts or Cadmium plated nuts as directed by Engineer-in-charge.

5. *Mode of Measurement:*

Executed quantity will be measured on number basis. (i.e. each).

## Chapter 8 Overhead Systems(OH)

### 8.1 Steel Poles (OH-PL)

A) **Steel Tubular Poles (OH-PL/STP) Scope:**  
**Specification No (OH-PL/STP)**

Supply of steel tubular swaged pole (Swan type or otherwise) as per IS 2713: Part 2 1980, fabricated with earthing stud, pole base plate with required numbers of holes as per drawing and erecting the pole, including painting in provided foundation as per method of construction.

*Material:*

**Pole:** Steel tubular swaged pole (Swan type or otherwise) as per Table No 8/1 **Base plate:** MS Base plate of 30x30x0.6 cms.

**Pole Cap:** Pole cap 4 mm thick with inside diameter equal to outside Dia. of the pole and minimum height shall be 100 mm and welded or fixed with set screws.

**Earth Stud:** Earth stud 5/8"mm Dia. bolt welded to pole with required size nut and double G.I.

/M.S. washers **Paint:** Red oxide paint as primer, bituminous paint, Aluminium paint/ any other paint as per the instructions of engineer-in-charge.

**Method of construction:**

Before erection of pole base plate of size 30x30x0.6 cm shall be full length welded or fixed with 4 set screws at the bottom of the pole, a suitable hole of required diameter and at specified height shall be drilled and welded with knock out nipple for laying wires for street light poles at required height. The pole shall be then painted by 2 coats of red oxide paint and one coat of bituminous paint before erection for min 1/6 length which is to be buried in ground & after erection remaining portion to be painted by two coats of

aluminium paint. The pole shall be erected in provided pit with cement Concrete foundation and muffing in perfect plumb.

**Mode of Measurement:**

Executed quantity will be measured on number basis. (I.e. each) Supply and erection of Rolled Steel Joist (Girder) pole as per IS 2713, including painting in provided foundation as per method of construction. **Material:**

**Pole:** Rolled Steel Joist (Girder) As per Table No 8.1/2 **Base plate:** MS Base plate of 30x30x0.6 cms. **Hardware:** Nut and bolts for fixing earth wire **Paint:** Bituminous paint, Aluminium paint, Red oxide paint. **Method of construction:**

Before erection of pole base plate of size 30x30x0.6 cm shall be full length welded at the bottom of pole, a suitable hole of required diameter and at specified height shall be drilled for earth stud. The pole shall be then painted by 2 coats of red oxide paint as primer for full length and then by one coat of bituminous paint before erection for min.1/6 length which is to be buried in ground & after erection remaining portion to be painted by two coats of aluminium paint. The pole shall be erected in provided pit with cement concrete foundation and muffing in perfect plumb.

**Mode of Measurement:**

Executed quantity will be measured on number basis. (i.e. each)

**Table No. 8.1/2 Weight of various sizes of RSJ Poles with 8.5 meter length RSJ POLE Size**

	Weight per
<b>Meter</b> Rolled steel Joist 150x80 / 150x75mm	
14.9 Kg/meter Rolled steel Joist 200x100 mm	
25.4 Kg/meter	
Rolled steel Joist 175x90 mm	19.3 Kg/meter
Rolled steel Joist 100x116 mm	23.0 Kg/meter
Rolled steel Joist 125x75 mm	12.42 Kg/meter
Rolled steel Joist 152x152 mm	37.0 Kg/meter

**Rail Poles (OH-PL/RLP) Scope:**

**Specification No (OH-PL/RLP)**

Supply and erection of Rail Pole including painting in provided foundation as per method of construction.

**Material:**

**Pole:** Rail Pole 29.76 Kg/ meter, as per IS 2713 (Part II)

**Base plate:** MS Base plate of 30x30x0.6 cms.

**Hardware:** Nut and bolts for fixing earth wire

**Paint:** Bituminous paint, Aluminium paint, Red oxide paint.

**Method of construction:**

Before erection of pole, base plate of size 30x30x0.6 cm shall be full length welded or fixed with 4 set screws at the bottom of pole, a suitable hole of required diameter and at "specified height shall be drilled for earth stud. The pole shall be then painted by 2 coats of red oxide paint as primer for full length and then by one coat of bituminous paint before erection for 1/6 length which is to be buried in ground & after erection remaining portion is to be painted by two coats of aluminium paint. The pole shall be erected in provided pit with cement concrete foundation and muffing in perfect plumb.

**Mode of Measurement:** Executed quantity will be measured on number basis. (i.e. each)

**C) G I Pipe Pole (OH-PL/GIP) Scope:**

**Specification No (OH-PL/GIP)** Supply and erection of ISI mark G.I. Pipe Pole 'B' Grade 75/80 mm dia. 6 m long including painting in provided foundation as per method of construction.

*Material:*

**Pole:** ISI mark G.I. Pipe Pole 'B' Grade 75/80mm dia. of total length 6 meter **Base plate:** CI/MS Base plate of 30x30x0.6 cms.

**Pole Cap:** Pole cap 4 mm thick with inside diameter equal to outside Dia. of the pole and minimum height shall be 75 mm shall be welded or fixed with set screws.

**Earth Stud:** Earth stud 5/8"mm Dia. size bolt welded to pole with required size nut and double G.I. /M.S. washers

**Paint:** Bituminous paint, Aluminium paint/ any other paint as per the instructions of engineer- in-charge, Red oxide paint.

**Method of construction:**

Before erection of pole base plate of size 30x30x0.6 cm shall be full length welded or fixed with 4 set screws at the bottom of pole, a suitable hole of required diameter and at specified height shall be drilled and welded with knock out nipple for laying wires of street light. The pole shall be then painted by 2 coats of red oxide paint as primer and one coat of bituminous paint before erection for 1/6 length which is to be buried in ground & after erection remaining portion to be painted by two coats of aluminium paint. The pole shall be erected in provided pit with cement concrete foundation and muffing in perfect plum.

**Mode of Measurement:**

Executed quantity will be measured on number basis. (i.e. each)

## Brackets(BKT) Pole Bracket (Cross arnti)(OH-PUBKT)

**Specification No** (OH-PUBKT)

**Scope:**

Supply and erection of MS Pole Bracket for erection of L T insulators on provided pole.

**Material:**

Pole Bracket: MS pole bracket fabricated as per specifications in Table 8.4/1. Thickness and size of channel is to checked from the steel table.

*Table No 8.4/1*

**Details of Pole Brackets**

Item No	Material of bracket	Length	No of insulator	No of insulator	Guarding Extension piece	Remark
8-4-1	Angle iron 50x50x6	550 mm	2	2		For LT guarding vertical
8-4-2	Angle iron 50x50x6 mm	750mm	2	2		For LT guarding for horizontal formation
8-4-3	ISMC Channel 75x40x 4.7mm		4	4		For LT 3 phase 4 wire vertical formation
8-4-4	ISMC Channel 75x40x 4.7mm		5	5		For LT 3 phase 5 wire vertical formation
8-4-5	ISMC Channel 75x40x 4.7mm	550 mm	2	2		
8-4-6	ISMC Channel 75x40x 4.7mm	1100 mm	4	4		
8-4-7 └	ISMC Channel 75x40x 4.7mm	550 mm	2	2	300mm of same channel	
8-4-8	ISMC Channel 75x40x 4.7mm	1100 mm	4	4	300mm of same channel	

**D' type Clamps:** MS Flat of 50x6mm, 15 mm MS nut bolts *Paint:* Silver paint, Red oxide paint

**Method of construction:**

The cross arm shall be made up of size of channel mentioned in above table. The length shall be as stated above table. The cross arm shall be complete with pole clamp of size 50X6 mm MS flat and holes required for pin / shackle insulator. For MS pole bracket with guarding extension, a extension piece of same size of length 300 mm shall be welded to bracket as per drawing attached herewith. The cross arm and pole clamp shall be painted with one coat of red oxide and two coat/silver enamel paint any other colour paint (as per the instructions of engineer in-charge). Cross arm shall be fabricated as per drawing no.

**Mode of Measurement:** Executed quantity will be measured on number basis, (i.e. Each)

**B) Aluminium Conductor. Steel Reinforced (ACSR) (OH-**

CGN/ACSR) Scope:

Specification No (OH-CGN/ACSR)

Supply and erection of aluminium conductor steel reinforced for overhead line. Material:

*Conductor:* All aluminium conductor steel reinforced (As per table 8.5/1) *Binding wire:* 12 SWG aluminium binding wire C/amper: PG clamps as per requirement

**Method of construction:**

At. first the conductor "is removed from bundle/drum straighten without knots, -bends, etc. Stringing of conductor shall be done with draw vice. Conductor shall not be twisted while stringing. Disc insulators shall be used if. the line deviates by 30 degrees or more, terminal pole and tri-pole or four pole structure at terminal pole and at junction/ cut pole. Parallel double groove clamp having two nut bolts designated to carry full line current shall be used for making Jumper wire connections. Universal .parallel double groove clamp having two nut bolts shall be used for Tap Off point.

On straight line the conductor shall be bounded on top groove of insulator and at angular position, binding shall be done in side groove. Binding wire of 12 SWG shall be of the same metal as that o ' conductor.

**Mode of Measurement**

For measurement purpose, sum of the total conductor including jumper connections shall be considered,(i.e. per km)'

Table No 8.5/1 Conductor Specifications As Per I.'S.

398/1961

Code Name of Conductor	Resistance at 20° ohm /km.	Approx, Current Carrying Capacity in Amperes.		Number of Strands / Diameter of each	Overall Diameter of Conductor in	Weight of Conductor (kg/km)
		At 40°C	At 45° C			
<b>AH Aluminium Conductor</b>						
Rose	1,361	116	108	7/1 .96	5.88	58
Gnat	1.071	133	123	7/2.21	6.63	73
Irish	0.850	150	138	7/2.48	7.44	92
Pansy	0.677	178	165	7/2.78	8.34	116
Ant	0.544, -	204	189	7/3.10	9.30	144
<b>ACSR Conductor</b>						
Squirrel	1.374	115	107	6+ 1/2.11	6.33	85
Weasel	0.911	150	139	6+ 1/2.59	7.77	128
Ferret 4.G4	0.67g	181	168	6+ 1/3.0	9.00	171
Mink 0.06	0.456	234	217	6+ 3.66	10.98	255
Raccoon	0.365	270	250	6+ 1/4.09	12.27	318
Dog 0.1	1.137	520	482	30+ 7/3.0	21.00	976

**Table No 8.5/2 Minimum Clearances between Conductors (13:4237-1967)**

S. No.	Voltage level (kV)	Clearance in mm	
		Between Phases	Between Phase & Earth
7.	11	460	305
8.	22	610	460
9.	33	915	610
10.	110	1675	1000
11.	230	3350	1675
12.	400	4000	3500

**8.5 Conductors(CON)  
All Aluminium Conductors (AAC) (OH-CON/AAC)**

**Scope:**

**Specification No (OH-CON/AAC)**

Supply and erection of All Aluminium Conductors for overhead line.

**Material:**

**Conductor:** All aluminium stranded conductor (As per table 8.5/1)

**Binding wire:** 12 SWG aluminium

binding wire

**Clamps:** PG clamps as per requirement

**Method of construction:**

At first the conductor is removed from bundle/drum straighten without knots, bends, etc. Stringing of conductor shall be done with draw vice. Conductor shall not be twisted while stringing. Shackle insulators shall be used if the line deviates by 30 degrees or more, at terminal pole and at junction/ cut pole. Parallel double groove clamp having two nut bolts designated to carry full line current shall be used for making Jumper wire connections. On straight line the conductor shall be bounded on top groove of insulator and at angular position binding shall be done in side groove. Binding wire of 12 SWG shall be of the same metal as that of conductor.

*Mode of Measurement:*

For measurement purpose, sum of the total conductor including jumper connections shall be considered. (i.e. per km)

**B)Aluminium Conductor Steel Reinforced (ACSR) (OH-CON/ACSR) Scope:**

**Specification No(OH-CON/ACSR)**

Supply and erection of aluminium conductor steel reinforced for overhead line. **Material: Conductor:** All aluminium conductor steel reinforced (As per table 8.5/1) **Binding wire:** 12 SWG aluminium binding wire

**Clamps:** PG clamps as per requirement

**Method of construction:**

At first the conductor is removed from bundle/drum straighten without knots, bends, etc. Stringing of conductor shall be done with drawing vice. Conductor shall not be twisted while stringing. Disc insulators shall be used if the line deviates by 30 degrees or more, terminal pole and tri-pole or four pole structure at terminal pole and at junction/ cut pole. Parallel double groove clamp having two nut bolts designated to carry full line current shall be used for making Jumper wire connections. Universal parallel double groove clamp having two nut bolts shall be used for Tap Off point. On straight line the conductor shall be bounded on top groove of

insulator and at angular position binding shall be done in side groove. Binding wire of 12 SWG shall be of the same metal as that of conductor.

*Mode of Measurement:*

For measurement purpose, sum of the total conductor including jumper connections shall be considered. (i.e. per km)

## 8.6 Insulators (INS)

*A) Porcelain Disc Type Insulator 11/22/33 kV (OH-INS/DI) Scope:*

### **Specification No (OH-INS/DI)**

Supplying porcelain disc type insulator, suitable for 11/22/33KV and necessary ancillary materials and complete erection on provided cross arm / bracket and connected to the overhead line as per instructions from the site engineer

*Material:*

**Insulator:** Distribution class Disc type insulator made from porcelain, suitable for specified voltage level, having ISI mark, with necessary hardware.

**Hardware:** Nuts, washers, etc.

**Binding wire:** Bare Copper wire or conductor.

**Clamps:** MS clamps.

*Method of construction:*

Distribution class porcelain disc type insulator, suitable for specified voltage level, erected on provided cross arm or bracket with clamps, ancillary materials, and connected to the over-head line. Connection shall be made with bare copper wire of specified gauge. **Mode of Measurement:** Executed quantity will be measured on number basis (i.e. each)

*B) Pin Type Insulator 11/22/33 kV (OHINS/PN) Scope:*

### **Specification No (OH-INS/PN)**

Supplying porcelain Pin type insulator, suitable for 11/22/33KV and necessary ancillary materials and complete erection on provided cross arm / bracket and connected to the overhead line as per instructions from the site engineer

*Material:*

**Insulator:** Distribution class Pin type insulator made from porcelain, suitable for specified voltage level, having ISI mark, with necessary hardware.

**Hardware:** Nuts, washers, etc.

**Binding wire:** Bare Copper wire or conductor.

**Clamps:** MS clamps.



*Method of construction:*

Distribution class porcelain pin type insulator, suitable for specified voltage level, erected on provided cross arm or bracket with clamps, ancillary materials, and connected to the overhead line. Connection shall be made with bare copper wire of specified gauge. **Mode of Measurement:** Executed quantity will be measured on number basis (i.e. each)

*C) Post Type Insulator 11/22/33 kV (OH-INS/PST) Scope:*

**Specification No (OH-INS/PST)**

Supplying porcelain Post type insulator, suitable for 11/22/33KV and necessary ancillary materials and complete erection on provided cross arm / bracket and connected to the overhead line as per instructions from the site engineer

*Material:*

**Insulator:** Distribution class Post type insulator made from porcelain, suitable for specified voltage level, having ISI mark, with necessary hardware.

**Hardware:** Nuts, washers, etc.

**Binding wire:** Bare Copper wire or conductor.

**Clamps:** MS clamps.

*Method of construction:*

Distribution class porcelain post type insulator, suitable for specified voltage level, erected on provided cross arm or bracket with clamps, ancillary materials, and connected to the overhead line. Connection shall be made with bare copper wire of specified gauge. **Mode of Measurement:** Executed quantity will be measured on number basis (i.e. each)

*D) Thyrite type Lightning Arrestor 11/22 kV (OH-INS/LA)*

*Scope:*

**Specification No (OH-INS/LA)**

Supplying porcelain Thyrite type lightning arrestor, suitable for specified voltage level and necessary ancillary materials and complete erection on provided cross arm / bracket and connected to the over-head line as per instructions from the site engineer.

*Material:*

**Arrestor:** Distribution class Thyrite type lightning arrestor made from porcelain, suitable for Specified voltage level, having ISI mark.

**Hardware:** Nuts, washers, etc.

**Binding wire:** Bare Copper wire or conductor.

**Clamps:** MS clamps.

*Method of construction:*

Distribution class porcelain Thyrite type lightning arrestor, suitable for specified voltage level, erected on provided cross arm or bracket with clamps, ancillary materials, and connected to the overhead line. Connection shall be made with bare copper wire of specified gauge. **Mode of**

**Measurement:** Executed quantity will be measured on number basis (i.e. each)

## 5.1 Plate / Pipe type Earthing

5.2

A) Plate type Earthing (With or Without C\ Cover, Funnel, etc) (EA-EP)

### Scope

**Specification No** (EA-EP)

Supplying and erecting. Galvanized cast iron /copper earth plate type / G.I. pipe type earthing with / without C.I. cover as per instructions from the site engineer.

### Material:

*Earth Plate:* Galvanized cast iron / Copper earth plate or GI pipe as per specifications given in Table No 9.1/1 .

*C\ Cover:* As per specifications given in Table No 9.1/1 .

*Earthing Conductor;* Copper/G.I strip/ Annealed bare copper wire/G.I. earth wire of size as per specifications given in Table No 9.1/1 .

*GI Pipe;* As per specification (CW-PLB/GP) mentioned chapter no. 17.5 for watering, and as enclosure for Earth wire, refer specifications given in Table No 9.1/1 , *Hardware:* Screw./ nut bolts with required washer of dimensions, Raw! plug / clip/ 'IT nails and material as per specifications given in Table No 9. 1/1. *Finishing material;* Coal) /Charcoal/ salt as per specifications given in Table No 9.1/1 . as per specifications given in Table No 9.1/1.

*Lugs:* As per specification (CB-LG/AL, CB4.G/CU) mentioned chapter 7.9 & 7.10 Copper/ Aluminium lugs as per specifications given in Table No 9.1 /1

### Method of construction:

Pit is to be dug of required dimension and depth for the earthing at site, and laying of Galvanized cast iron / Copper earth plate or G.I. pipe shall be as per Table No 9,1/1. The earth connection to equipment switch gear ant) earthing electrode shall be connected as shown in the diagram and as per IS 3043 amender up to-date. The connections shall be made either by strip or double run of earth wire with drilling, welding, riveting, brazing and nut bolting to plate or pipe, where ever required in an approved manner. As far as possible Continuous strip shall be used, but where ever jointing of strip is unavoidable; the overlap portion must not be less than  $2^{1/2}$  times the width of the strip either welded/ brazed/soldered by all sides or 6 inches overlap with two nut bolts/ riveting of adequate size with required washer and covered by anti-corrosive paint as per approved jointing practice in the industry and as per directives from site engineer in charge. Pit shall then be filled with screened soil with alternate layer of coal and salt, and if, necessary brick masonry work ( Where ever applicable) shall be done as specified in IS: 3043, with laying wires in PVC/ G.I. pipe and watering arrangement as per drawing no EA-1 and covered with C.I. Cover ( Where ever applicable).

Where ever requires or as specified by Site Engineer, a Test link shall be provided for facilitating the testing of resistance of earth electrode.

Testing:

The value of each earth electrode shall be measured by earth tester in presence of site Engineer and record to be s

**Mode of Measurement :** Executed quantity will be measured on number basis (i.e. each)Table No 9.1/1 Detailed Specifications of various types of Earthing

Type of earthing		Galvanized cast iron earth plate type without C.I cover	Copper earth plate type with C.I cover	Galvanized cast iron earth plate type with C.I cover	Pipe type earthing with out C.I cover
S.No	Particulars				
1)	Depth from top of plate Up to Ground level	1.5 m Galvanized	1.5m	1.5m Galvanized '	
2)	Size & type of material for pipe / Plate type earthing.	Cast iron earth plate size 60x60x0.6 cms	Copper earth plate size 60x60x3.15 cms	cast iron earth plate size 60x60x0.6 cms	'B' grade G.I. pipe - 40mm, dia. 2.5 mtr. Long or 20 mm dia.
3)	Salt/charcoal	30 Kg. charcoal and salt each	30 Kg. charcoal and salt each	40 Kg. charcoal and salt each	NA-
4)	Type of Wire	Double G.I. wire 8 SWG	Double G.I. 8 SWG	Double G.i. 6 SWG	double G.i. 8 SWG
5)	Wire enclosure	12mm. dia. G. I. pipe 2 mtr. Long	12mm. dia. G. I. pipe 2 mtr. Long	12mm. dia. G. I. pipe 2.5 mtr. Long	NA
6)	Nut bolts	12 mm dia. Cadmium/	12 mm dia. Cadmium	12 mm dia. Cadmium	NA
7)	Washers	GI	GI	GI	NA
8)	Watering pipe	19mm. dia G.I. pipe	19mm. dia. G.I. pipe	19mm. dia. G.I. pipe	NA
9J)	Lugs	Yes	Yes	Yes	Yes
10)	funnel	No	yes	yes	NA
11)	Brick Masonry	No	yes	yes	NA

*Cable Trench (CTR)*

**1. General**

This part of specification deals with the preparation of trenches in soft soil, hard murum, BT road, and laying of cables inside the trench, etc as per IS: 1255,

**2. Scope:**

**Specification No (CW-EXN/CTR)**

Excavating in all types of soil strata and making trench for laying cable/cables, providing sand bed for laying the cable, covering cable with specified material as per requirement, and finishing the same by making the surface proper with crown on top of the trench. •

The following list shows Indian Standards, which are acceptable as good practice, and accepted standards.

SP 30: 1984	:	National Electrical Code
SP 7 (Group 4); 2005	:	National Building Code
IS 1255: 1967	:	Code of practice of Installation & Maintenance of armoured cables up to 33 kV.

**3. Material:**

**Bricks:** Solid Clay bricks of minimum size 225x110x62.5 mm (L x B x H), burnt in the kiln, of good quality.

**Sand:** Screened sand of good quality.

**4. Method of Construction:**

Trench in Soft soil / Hard Murum / Tar road" Single run of cable Before excavating the soil for preparing trench, route of cable laying shall be got finalized from the site in-charge. Trench of minimum 300 mm width shall be excavated up to . minimum depth below the ground surface as per Table No 17.1/1 Bottom of the trench should be carefully leveled and freed from stones. Cable duly straightened shall be laid flat and embedded in the 200 mm layer of screened sand at the bottom of the trench. Bricks shall be laid all over the run of cable as specified below:

Lengthwise for cable up to and including 10 Sq mm of all cores. Width wise for cable above 10 Sq mm of all cores.

Remaining portion of the trench shall be back filled with the excavated material after removing stones and sharp / hard material, and making the surface proper. Crown of 150 mm shall be provided over the trench. The remaining excavated materiaf shall be removed from site and dumped in scrap yard of Local authorities or at suitable place.

Trench in Soft soil / Hard Murum / Tar road: Two or more cables run of cable Before excavating the: 5oii for preparing trench, route of cable laying shall be got finalized from the site in-charge. Trench of minimum required width more than 300mm. shall be excavated up to minimum depth as per Table No

5, below the ground "Surface. Bottom of the trench should be carefully leveled and freed from stones. Cables duly straightened shall be laid flat and embedded in the 200 mm layer of screened sand. The inter-axial distance between two cables shall be between 230 and 400 mm. at the bottom of the Trench. Bricks shall be laid ail over the run of cable as specified below:

Lengthwise for cable up to and including 10 Sq mm of all cores. Width wise for cable above 10 Sq mm of all cores. Remaining-.portion of the trench shall be back filled with the excavated material after removing stones and sharp / hard material, and making the surface proper. Crown of 150 mm shall be provided over the trench. The remaining excavated material shall be removed from site .and dumped in scrap yard of Local authorities or at suitable place. **Trench** in Soft soil/Hard Murum/Tar road with half round Hume pipe:

**(For cables of size 25 Sq mm. and above shall be covered mln. 150 mm. dia. of RCC Hume pipe)**

Before excavating the soil for preparing trench, route of cable laying shall be got finalized from the site in-charge. Trench of minimum required width more than 300mm. shall' be excavated up to minimum depth as per Table No 5, below the ground surface. Bottom of the trench should be carefully leveled and freed from stones. Cables duly straightened shall be laid flat and embedded in the 200 mm layer of screened sand. The inter-axia<sup>2</sup>A distance between two cables shall be between 230 and 400 mm. at the bottom of the trench, inverted 150mm. dia. Half round RCC Hume pipe shall be laid above full length of cable. For more than one-cable higher size or more number of Hume pipes are to be provided.

Remaining portion of the trench shall be back filled with the excavated material after removing stones and sharp / hard material, and making the surface proper. Crown of 150 mm shall be provided over the trench, The remaining excavated material shall be removed from site and dumped in scrap yard of Local authorities or at suitable place.

As per 3.1 above, in place of bricks, the cable of size 25 sq.mm and above shall be covered with 150 mm dia, half round Hume pipe.

4.4 Mode of Measurement:

Executed quantity shall be measured on the basis of running meter per run of cable.

S.No	Voltage level of cables	Minimum depth from top of the cable
1	Up to 1.1 kV	750 mm
2	3,3 kV to 11 kV	900 mm
3	22kV to 33kV	1050mm
4	At road crossing	1000 mm
5	At railway crossing {from Bottom of sleepers to Top of pipe)	1000 mm

## 5.8 LT – Air Circuit Breakers

(ACB)

**Scope:** Specification No (SW-SWR/ACB) Supplying, erecting, and commissioning of Air Circuit breaker of specified rating, confirming to IS 2516/IES157 manually operated non draw out type/draw out type erected at position in provided panel board in approved manner.

**Material:** Air Circuit Breaker: Draw out type/non draw out type manually quick make quick break type front operated mechanical indication for ON/OFF position with 50 kA short circuit rating. Trip free mechanism with high performance characteristic based on modular construction and should be compact. The breaker shall have following accessories:

- Auxiliary Switch: Auxiliary switch shall consist of 2 NO & 2 NC contacts. The total Auxiliary switch block shall have minimum six auxiliary. In case of draw out breakers two

sliding contacts should be provided. Alarm Switch: For breaker with thermal and magnetic trip units the indication should be direct from trip unit through micro switch with necessary wiring.

- Shunt Release: Shunt trips are used for remote control. Shunt trip coil should operate through an auxiliary switch. The operating ranges should be normally 50-110 % of the rated voltage.

- Under voltage Release: Under voltage release must be energized before closing breaker. This should be provided for remote control. Over current release: Over current release shall consist of Current Transformer with slides on each current carrying path of a bi-metal relay common to all transformers. The transformer shall have a fix ratio suited to particular setting range. Overload releases shall be thermal time lagged. Overload relay range shall be 50 % to 100 % of CT ratio. Frame shall facilitate site adjustment from 25-100% of ACB rating to match the load requirement.

- RA unit - given for 0-110% operating range of SHT-ensures supply available to shunt trip from same AC source in short circuit condition.

- RC unit – for up to 3secs. Timedelay wit U/V trip. Ideal for protection against transient voltage dips and nuisance tripping continuously adjustable time delay range of 40-500 ms with S/c trip ideal for selective interruption co- ordination of ACB's.

- Contacts made of electrolytic copper of 99.9 % purity, of ACB shall be totally shrouded, for eliminating access to live parts.

- Short Circuit release pick up shall be adjustable for closer protection.

- Breaker shall be compact in size, for saving space in the cubicle and as far as possible shall be lightweight for easy handling.

- Thermal over load and magnetic short circuit protection shall be provided.

**Method of Construction:** The breaker should be erected on provided panel board or cubicle as the case may be, complete with connecting to bus bar by means of provided insulated copper strip of suitable cross section as per the rating, complete.

Mode of Measurement: Executed quantity shall be counted on number basis. (i.e. each)

## 5.9

HT -- SFU's, Load Break Switch (HTS)

A. HT Switch Fuse Unit/ Load Break Switch (LBS) Scope: Specification No (SW-HTS/LBS) Supplying and erecting extendable/ non extendable type load break switch with fuses of required rating and with IP 55 protection class, on provided MS channels/ trench/ foundation in an approved manner.

Recommended Standards:

IS 9920 (Latest Revision):- Rating, performance, testing of load break switch

IS 9921 :- Standards for temperature of electrical parts exposed to air

Load Break Switch should normally comply with the following parameters:

S. No	Specifications	11 KV	22 KV
1	Rated Voltage	12 KV	24 KV
2	Rated Current	630A	630 A
3	Rated short time current	25 KA	25 KA
4	Rated making current	62.5 KA	62.5 KA
5	Rated breaking current	630A	630 A
6	Impulse withstand voltage Earth and the between poles 75 KV 125 KV Across isolation distance	85 KV	145 KV
7	Power frequency test voltage Earth and between poles 28 KV 50KV Across the isolation distance	32 KV	60KV

Material:

- Steel Sheet
- Electrolytic Aluminium Bus bar of 400A
- Arc Chutes
- Epoxy Resin Cast Type Insulators
- H.T. Fuses of adequate capacity
- Shunt Trip Coil
- Manual trip push button
- Auxiliary contacts
- Earth switch
- Earth Bus bar copper (25x3)

**Method of Construction:** Load break switch should be erected on provided MS channels/ trench/ foundation as per approved drawing by site in charge. Manufacturer's certificate for type test should

be obtained. Routine Type test should be carried out at site. An earth switch having separate operating handle should be interlocked with main switch should be checked. An operating handle with correct sequence device having ON and OFF position and arrangement for pad locking provided should be checked. Application: Load break switch is suitable mainly for underground H.T. distribution system. It can be used for switching of transformers, overhead lines, capacitors, ring mains and cables.

**Mode of Measurement:** Executed quantity will be counted on number basis. (i.e. each)

#### B. Ring Main Unit: (RMU)

*Scope:*

##### **Specification No (SW-HTS/RMU)**

Supplying and erecting Indoor type ring main unit with 2 incoming and 1 outgoing with HRC fuses and with IP 55 protection class, complete erected on provided CC foundation/ MS channels/ trench in an approved manner. (Refer drawing no. SW-HTS-1) Recommended Standards: IS 9920 (Latest Revision):- Rating, performance, testing of Ring Main Unit IS 9921 :- Standards for temperature of electrical parts exposed to air

**Material:** • Steel Sheet • Electrolytic copper Bus bar of 400 A • Arc Chutes • Epoxy Resin Cast Type Insulators • H.T. Fuses of adequate capacity • Shunt Trip Coil • Manual trip push button • Auxiliary contacts • Earth switch • Earth Bus bar copper (25x3)

Method of Construction: Ring main unit should be erected on provided MS channels/ trench/foundation as per approved drawing by site in charge. Manufacturer's certificate for type test should be obtained. Routine Type test should be carried out at site. An earth switch having separate operating handle should be interlocked with main switch should be checked. An operating handle with correct sequence device having ON and OFF position and arrangement for pad locking provided should be checked.

**Application:** Ring Main Unit is suitable mainly for underground distribution system. It can be used for switching of transformers, overhead lines, capacitors, ring mains and cables Mode of Measurement: - Per RMU

**Mode of Measurement:** Executed quantity will be counted on number basis. (i.e. each)

#### **4. Dismantling**

Cable laid underground, or fixed on any surface shall be dismantled carefully without damaging complete with all its accessories, making coil and stored as directed. The surface of the dismantled cable shall be made clear by removing of unwanted material, cement mortar, etc. When cable is dismantled from trench refill back the trench and making the surface proper.

**Mode of Measurement:** Executed quantity shall be measured on the basis of running metre per run 9-1-5 B) Low Impedance Earthing (Pipe in pipe technology)D(EA-EPP)



Scope;

### **Specification No D(EA-EPP)**

Supplying -and erecting approved type earthing system with Pipe in pipe technology with necessary ancillary materials and complete erection as per instructions from the site engineer.

**Material:** GI Pipe: As per specification no. (CW-PLB/GP) mentioned chapter 17.5;

1. 50 mm dia. x 3 meter long (In place of traditional GI pipe Earthing), for LV /MV applications.
2. n 80 mm x 3 meter Song (In place of traditional copper plate Earthing), for HV/EHV applications.

Earthing Conductor: G.I strip/GI earth wire of size as per specifications given in the Table No 9.1/1.

**GI Pipe:** As per specification no. (CW-PLB/GP) mentioned chapter 17.5 for watering and as enclosure for Earth wire, as per specifications given in Table No 9.11\.

Hardware: Screw/ nut bolts with required washer of dimensions, Rawl plug/clip/ 'U\* Nails and material as per specifications given in Table No 9. / / / .

**Filling material:** Coal /Charcoal/ salt as per specifications given in Table No 9.1/1.

as per specifications given in Table No 9,1/1.

Lugs: As per specification no. (CB-LG/AL, CB-LG/CU) mentioned in chapter 7.9 & 7.10 for Copper/ Aluminium lugs and as per specifications given in Table No 9.1/1.

*Method of construction:*

Earthing Pipe in pipe technology with ancillary materials shall be done by digging an 8" / 10" dia. hand bore 10.5' deep sufficient to install the electrode in normal soil conditions. The space between the soil and the electrode is filled up with electrolyte material mixed with the dugout mother soil, along with water and tightly packed up to the base of the terminal. In rocky areas and under hard soil and sandy soil conditions the method of installation will be as specified by manufacturer. Installation shall include drilling, welding, reverting, brazing and nut bolting pipe when ever required in an approved manner with required material such as nut bolts and washer etc. and with necessary brick masonry work as per the specification. (As per IS 3043 amended up to-date). As far as possible continuous GI strip shall be used but when ever jointing of strip is un avoidable, the jointing over lap portion must not be less than 21/2 times the width of the strip either welded/ brazed/soldered by all sides or overlap of 6 inch with two nut bolts/ riveting of adequate size with required washer and covered by anti corrosive paint as per approved jointing practice in the industry and as per directives from site engineer in-charge.

*Testing:*

The value of each earth electrode shall be measured by earth tester and record to be Q submitted. (Also refer drawing No.2)

**Mode of Measurement:** Executed quantity will be measured on number basis i.e. Each

## **9.1 Plate / Pipe type Earthing**

A) Plate type Earthing (With or Without C\ Cover, Funnel, etc) (EA-EP)

*Scope*

**Specification No (EA-EP)**

Supplying and erecting. Galvanized cast iron /copper earth plate type / G.I. pipe type earthing with / without C.I. cover as per instructions from the site engineer.

*Material:*

*Earth Plate:* Galvanized cast iron / Copper earth plate or GI pipe as per specifications given in Table No 9.1/1.

*CI Cover:* As per specifications given in Table No 9.1/1 .

*Earthing Conductor;* Copper/G.I strip/ Annealed bare copper wire/G.I. earth wire of size as per specifications given in Table No 9.1/1.

*GI Pipe;* As per specification (CW-PLB/GP) mentioned chapter no. 17.5 for watering, and as enclosure for Earthwire, refer specifications given in Table No 9.1/1 , *Hardware:* Screw./ nut bolts with required washer of dimensions,

Raw! plug / clip/ 'IT nails and material as per specifications given in Table No 9. 1/1. *Finishing material;* Coal) /Charcoal/

salt as per specifications given in Table No 9.1/1 . as per specifications given in Table No 9.1/1. Lugs: As per specification (CB-LG/AL, CB4.G/CU) mentioned chapter 7.9 & 7.10 Copper/ Aluminium lugs as per specifications given in Table No 9.1 /1 .

*Method of construction:*

Pit is to be dug of required dimension and depth for the earthing at site, and laying of Galvanized cast iron/ Copper earth plate or G.I. pipe shall be as per Table No 9,1/1. The earth connection to equipment switch gerent ) earthing electrode shall be connected as shown in the diagram and as per IS 3043 amender up to-date.

The connections shall be made either by strip or double run of earth wire with drilling, welding, riveting, brazing and nut bolting to plate or pipe, where ever required in an approved manner. As far as possible Continuous strip shall be used, but where ever jointing of strip is unavoidable; the overlap portion must not be less than 2times the width of the strip either welded/ brazed/soldered by all sides or 6 inches overlap with two nut bolts/ riveting of adequate size with required washer and covered by anti-corrosive paint as per approved jointing practice in the industry and as per directives from site engineer in charge. Pit shall then be filled with screened soil with alternate layer of coal and salt, and if, necessary brick masonry work ( Where ever applicable) shall be done as specified in IS: 3043, with laying wires in PVC/ G.I. pipe and watering arrangement as per drawing no EA-1 and covered with C.I. Cover ( Where ever applicable).

Where ever requires or as specified by Site Engineer, a Test link shall be provided for facilitating the testing of resistance of earth electrode.

*Testing:*

The value of each earth electrode shall be measured by earth tester in presence of site Engineer and record to be s

**Mode of Measurement:** Executed quantity will be measured on number basis (i.e. each)

*10.1 Transformer (TR)*

**Scope: Specification No (SS-TR)**

Supplying and erecting AC three phase 11or 22 kV/0.44 kV, 50 Hz, oil immersed and naturally cooled indoor/outdoor type copper wound distribution transformer of specified capacity, connected delta on HV side and star on LV side with additional neutral brought out on load side.

*Recommended standards:*

The following list shows Indian Standards which are acceptable as good practice and accepted standards.

IS 335: 1963 Dielectric Strength IS 2026 part I 1977 Specification for Transformer IS 2026 part II 1977 Specification for type of cooling and permissible temp. Rise of transformer

IS 2026 part III 1981 Specification for insulation level and dielectric strength of transformer IS 2026 part IV 1977 Specification for terminal marking tapping and connections.

IS 1180 part I 1989 Specification for outdoor type three phase distribution transformer

IS 10028 Part I 1985 Code of practice for selection installation and maintenance of transformers

CBIP/TAC Manuals

*Material:*

1. Copper wound Transformer with Delta connection on HV side and star connection on LV side complete with Manufacturer's test certificates

2. Standard mountings required for transformer are shown below. The mountings are to be selected from them and any additional if required.

- Off load tap changing
- Oil conservator with fitting holes and cap and plain oil level gauge
- Silica gel dehydrating breather
- Oil drain valve
- Thermometer pockets
- Oil filter valve
- Lifting arrangement
- Two earthing terminals
- Diagram and rating plate
- Four bi directional plain rollers
- Air vent
- Explosion vent
- Terminal arrangement
- Bushing with lugs and/or cable end box on LV side
- HV cable end box and/or HV bushing

The transformer losses shall be as mentioned in Table No 10.1/1

*Method of Construction:*

The contractor should intimate name of manufacturer and make of the Transformer and location of the manufacturer factory to engineer in charge prior to delivery of the transformer. After manufacturing of the transformer, the agency/contractor shall intimate the engineer-in-charge for carrying out the inspection.

After receipt of intimation engineer-in-charge or his representative should inspect the Transformer at manufacturer factory and shall carry out the following tests jointly in presence of concern contractor.

1. Open Circuit test
2. Short Circuit test
3. Specific Resistance Test
4. Insulation Resistance of HV, LV, in between HV and LV, Winding and Body.
5. Dielectric Strength and acidity test of Transformer oil.

The test results of joint inspection shall be recorded on the test report of Transformer with its Sr. No. prior to delivery of the Transformer to site. Necessary work of plinth and or for D.P. structure with D.O. set, L.A., A.B. switch should be completed before dispatch of the transformer. The channel arrangement on plinth is to be done. Earthing arrangement should be completed. The Transformer should be installed on plinths / double pole structure/floor by arranging chains pulley block, crane etc as per IS Norms.

After installation of Transformer the stopper/lock should be provided to rollers of the Transformer.

The connection of H.T/L.T. side should be completed by provided Copper wire/ cable with necessary lugs to avoid loose connection. The earthing (2 Nos for Neutral & 2 Nos for Body) should be connected from distinct electrodes. The earthing should be connected by lugs/proper size of strip. The Engineer in charge or his representative should check all connections on **H.T.** side, L.T. side and earths and insulation and earth resistance test should be carried out and results obtained shall be recorded. Statutory Permissions to be obtained by the Agency /Contractor. Before commencement of work, the drawings of installation shall be got approved from the Electrical Inspector, I E & L Department. The installation should be got inspected from Electrical Inspector and obtain written permission to charge the Transformers. Commissioning: After above formalities the Transformer, should be charged/commissioned in presence of Engineer in charge or his representative along with load trials and shall be handed over to the department for beneficial use After charging the Transformer, line, phase voltages and line current shall be measured, and the same shall be submitted.

**Following test certificates shall be submitted:**

1. Manufacturers original certificate of Transformer as stipulated in IS.
2. Test certificate for dielectric strength of oil as per IS.
3. Test results of IR values.
4. Test results of all earth electrodes.

Readings of Voltages & currents at the time of commissioning.

## 10.2 Accessories (AS)

**Scope: Specification No (SS-AS/FSG)**

Supplying and erecting fencing of section having size **2450 mm** in height from ground level and **1200 mm** width with angle iron frame work, erected in foundation, and painted.

*Material:*

**Fabrication material:** ISI mark 50x50x6 mm angle iron, Iron studs/Spikes 10 mm thick with arrow head, 25x6 mm MS flat iron.

**Chain link Jali:** Jali made from hard GI wire 10 SWG/3.26 mm dia.

**Foundation material:** Cement, Sand, Water.

**Paint:** Aluminium paint, Red oxide.

**Method of Construction:** The fencing shall be fabricated **as per drawing no. ....** The fencing section shall be 2450 mm in height from finished ground level and 1200 mm in width. The square jali shall be welded from inside of the angle iron frame measuring 2200mm (1800 mm for fencing frame + 400 mm for embedding in cement concrete foundation) in height and 1200 mm in width. On top the frame iron studs of minimum 150 mm in height with arrow head shall be welded with spacing of minimum 300 mm. Supports made from MS flat iron shall be welded width wise on the top the jali from inside the frame at top, middle and at the bottom. The entire structure shall be erected in plumb. After the entire fabrication, fencing shall be painted with one coat of red oxide and two coats of aluminium paint. (Overall size of doors shall be 1800 mm height x 3000 mm wide)

**Mode of Measurement:** Executed quantity will be measured on number basis.

(i.e each)

*A. Double leaf door for Sub Station (DLD)*

**Scope: Specification No (SS-AS/DLD)**

Supplying and erecting double leaf hinged door each 1500 mm in width x 1800 mm in height using B Class GI pipe with angle iron supports, chain link jali, complete supported on channel iron, erected in foundation, and painted.

*Material:*

**GI Pipe:** ISI mark, 25 mm diameter as per **(CW-PLB/GP)** for chapter 17.5

**Fabrication material:** ISI mark 45x45x5 mm angle iron, Iron studs/Spikes 10 mm **Channel iron:** ISI mark 100x 50mmx 5mm.

**Chain link Jali:** Jali made from hard GI wire 10 SWG/3.26 mm dia.

**Foundation material:** Cement, Sand, Water.

**Paint:** Aluminium paint, Red oxide.

**Method of Construction:** The door shall be fabricated as per drawing no. .... The door section shall be 1800 mm In height from finished ground level and 1500 mm in width. The door frame shall be fabricated from B class GI pipe 25 mm in diameter, with chain link jali welded into the frame. The jali shall be supported with cross bracing the 45x45x5 mm angle. The door shall be supported to the channel with hinges welded to door frame and the channel. On top the frame iron studs of minimum 150 mm in height with arrow head shall be welded with spacing of minimum 300 mm. The total length of the channel shall be minimum 2200 mm. The channel shall be embedded in cement concrete foundation. The doors shall have locking arrangement for restricting unauthorized entry and the lock shall be with minimum 6 levers with duplicate keys. The entire structure shall be erected in plumb. After the entire fabrication, fencing shall be painted with one coat of red oxide and two coats of aluminium paint.

**Mode of Measurement:** Executed quantity will be measured on number basis. (i.e each)

**MATERIAL SPECIFICATION CELL**

**TECHNICAL SPECIFICATION OF**

**11 KV AND 22 V MOTORISED, EXTENSIBLE / NON EXTENSIBLE RING**  
**MAIN UNIT SWITCHGEAR FOR SCADA PART B**

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## **Project Background:-**

The objective of the R-APDRP Project is to improve the reliability, efficiency, and loss reduction of the Utility's 11 kV distribution network. This is to be achieved by upgrading and/or replacing existing overhead lines and underground cables, constructing additional feeder segments and Ring Main Units (RMUs). The RMUs should be motorized and suitable to be connected to F-RTU so as to be monitored and controlled through SCADA/DMS.

### **1.00 SCOPE**

Design, Engineering, Manufacture, Assembly, Stage testing, Inspection and Testing before supply, Packing and delivery at site, Erection, Installation, testing & Commissioning of Outdoor type, SF6 gas filled 11 kV & 22 kV EXTENSIBLE / NON EXTENSIBLE Ring Main units, with various combinations of Load Break Isolators & Circuit Breaker for Distribution transformers center and feeders. The Ring Main units are to be installed in three phase, three wire, 11kV or 22 kV, 50 Hz, A.C. Distribution network.

The RMUs should be provided with necessary take off terminal units for future automations and all these units should be shielded in a outdoor metal-body for making them suitable for outdoor use. The insulation/dielectric media inside the Non ferrite & Non magnetic grade stainless steel welded tank should be SF6 gas. The RMUS should be of **extensible type on both sides**.

- 34.1 This Specification provides for design, manufacture, inspection and testing before despatch, packing and delivery F.O.R.(Destination) of SF6 insulated RMUs with necessary take off terminal units for future automations, other accessories and auxiliaries equipments and mandatory spares, described herein and required for their satisfactory operation.
- 34.2 The objective of the RMUs is for extremely small construction width, compact, maintenance free, independent of climate, easy installation, operational reliability, Safe and easy to operate, minimum construction cost, minimum site work and minimum space requirement.
- 34.1 The RMUs shall conform in all respects to high standards Of Engineering design, workmanship and latest revisions of relevant standards at the time of offer.
- 34.2 The type of the 11 KV and 22 KV circuit breaker shall be VCB and insulating medium for load break isolators, Earth switch, 11 KV and 22 KV Buses and other associated equipments should be SF6 gas.

### **2.1 GENERAL**

The Ring Main Unit shall be installed at 11 KV and 22 KV junction points such as 200KVA, 315 kVA and 630 KVA Distribution transformer centers and feeders to have continuous supply by isolating faulty sections. The RMU shall be extensible on both sides and consists

of the following combinations of load break switches and Circuit breakers for a nominal voltage of 12 KV for 11 KV RMU and 24 KV For 22 KV RMU using SF6 gas as insulating and Vacuum as arc quenching medium.

The RMU and combination shall be tropicalised and outdoor metal enclosed type with minimum IP 54 protection. The RMU metal parts shall be of high thickness, high tensile steel which must be grit/short blasted, thermally sprayed with Zinc alloy, phosphate or should follow the 7 tank pre-treatment process and be subsequently painted with polyurethane based powder paint. The overall paint layer thickness shall be not less than **80 microns**.

Relevant IE rules for clearances, safety and operation inside the enclosure shall be applicable. **The complete Ring Main Unit shall be** type tested at recognized laboratories by National Accreditation Board of Testing and Calibration Laboratories (NABL) in India or Abroad successfully.

All live parts except for the cable connections in the cable compartments shall be insulated with SF6 gas. The SF6 gas filled main tank shall be Robotically welded Non ferrite & Non magnetic grade stainless steel sheet of minimum 3 mm thickness, to have the best weld quality and provided with a pressure relief arrangement away from operator. The SF6 gas pressure in the tank shall be constantly monitored by temperature compensating gas pressure indicator offering a simple go , no- go indication. The gas pressure indicator shall be provided having distinctive RED and GREEN zones for safe operation.

The SF6 gas tank shall be of completely sealed construction. The degree of protection of main SF6 gas tank shall be IP 67. There shall be one Non-return valve to fill up the gas.

The connection of different welded sections of gas tank by gasket and bolts, to form a RMU chamber is not acceptable. Oil or Air filled switchgear will not be considered.

The cable box of isolators and circuit breakers shall be from front/side/rear as per clause no.13.

Any accidental over pressure inside the sealed chamber shall be limited by the opening of a pressure-limiting device placed at top and rear end of the enclosure to release the SF6 Gas away from operator and to ensure highest safety general public safety.

The Entire units of RMU shall be enclosed in a single compact metal clad, outdoor enclosure with minimum IP 54 protection suitable for all weather conditions. The switchgear/steel gas tank shall be filled with SF6 as per IEC/IS Standards relative pressure to ensure the insulation and breaking functions. The steel gas tank must be sealed for life and shall meet the “sealed pressure system” criteria in accordance with the IEC 298 standard. The RMU must be a system for which no handling of gas is required throughout the 25 years of service life. The manufacturer shall be guarantee for maximum leakage rate of SF6 gas will be lower than 0.1 % per year. An absorption material such as activated alumina in the tank shall be provided to absorb the moisture from the SF6 gas to regenerate the SF6 gas

following arc interruption.

The RMU shall have a design such that in the event of an internal arc fault, the operator shall be safe. This should be in accordance with IEC 298 and relevant Test certificates shall be submitted with the Tender.

**The Complete RMU shall be tested for an internal arc rating of 20 kA for 3 Sec. for 11 KV and 16 KA for 3 sec for 22 KV System.**

Suitable temperature rise test on the RMU shall be carried out & test reports shall be submitted with tender for technical bid evaluation.

Each switchboard shall be identified by an appropriately sized label, which clearly indicates the functional units and their electrical characteristics.

The switchgear and switchboard shall be designed so that the position of the different devices is visible to the operator on the front of the switchboard and operations are visible as well.

The entire system shall be totally encapsulated. There shall be no access to exposed conductors. In accordance with the standards in effect, the switchboards shall be designed so as to prevent access to all live parts during operation without the use of tools.

The entire 11 KV RMU and 22 KV RMU are insulated by inert gas (SF<sub>6</sub>) suitable for operating voltage up to 12 KV and 24 kV respectively. The 11 KV/22 kV circuit breakers must be VCB breaker.

The height of bottom of cable box shall be 310mm to provide the turning radius for HT cable termination. The complete RMU Unit shall be provided with a pedestal made up of M.S. Angle to mount the unit on plain surface.

All the RMUs must be routine tested for the following at factory in India:-

- ☐ Micro-ohm test for the assembly inside the tank.
- ☐ Circuit breaker analyzer test so as to ensure the simultaneous closing of all poles for VCB.
- ☐ SF<sub>6</sub> gas leak test.
- ☐ Partial Discharge test on the complete gas tank so as to be assure of the proper insulation level and high product life.
- ☐ High voltage withstands.
- ☐ Secondary test to ensure the proper functioning of the live line indicators, fault passage indicators and relays.

### **Sulphur Hex fluoride Gas (SF6 GAS)**

The SF6 gas shall comply with IEC 376,376A, and 376B and shall be suitable in all respects for use in 11 KV and 22 kV RMUs under the operating conditions. The SF6 shall be tested for purity, dew point air hydrolysable fluorides and water content as per IEC 376,376A and 376B and test certificate shall be furnished to the owner indicating all the tests as per IEC

376 for each Lot of SF6 Gas.

### **3.00 STANDARDS**

Unless otherwise specified elsewhere in this Specification, the RMU, Switchboard (Switchgear), Load break isolators, Instrument Transformers and other associated accessories shall conform to the latest revisions and amendments there of to the following standards.

- |   |  |
|---|--|
| 1. IEC 60 298/IEC 62271-200/IS 12729:1988               | General requirement for Metal Enclosed switchgear  |
| 2. IEC60129/IEC62271-102/IS 9921                        | Alternating current disconnectors (Load break isolators) and earthing switch             |
| 3. IEC 62271-100/IEC 60056/IS 13118:1991/IEC 62 271-200 | Specification for alternating current circuit breakers.                                  |
| 4. IEC 62 271-1/IEC 60694                               | Panel design, SF6/Vacuum Circuit Breakers  |
| 5. IEC 60044-1/IEC 60185/IS 2705:1992                   | Current Transformer  |
| 6. IEC 60265/IS 9920:1981                               | High voltage switches  |
| 7. IEC 376  | Filling of SF6 gas in RMU.   |
| 8. IEC 60273/IS :2099                                   | Dimension of Indoor & Outdoor post insulators with voltage > 1000 Volts.                 |
| 9. IEC 60529/IS 13947(Part-1)-                          | Degree of protection provided by enclosures for low voltage switchgear and control gear. |

**10. All Indian Electricity Rules/Bills amended upto date applicable for clearances, safety and operation of equipment**

Equipment meeting with the requirements of any other authoritative standards, which ensures equal or better quality than the standard mentioned above shall also be acceptable. If the equipments, offered by the Bidder conform to other standards, salient points of difference between the standards adopted and the specific standards shall be clearly brought out in relevant schedule. In case of any difference between provisions of these standards and provisions of this specification, the provisions contained in this specification shall prevail. One copy of such standards with authentic English Translations shall be furnished along with the offer.(Hard copy)

**4.00 THE STANDARDS MENTIONED ABOVE ARE AVAILABLE FROM:  
REFERENCE / ABBREVIATION NAME AND ADDRESS FROM WHICH THE STANDARDS ARE AVAILABLE**

IEC	INTERNATIONAL ELECTRO-TECHNICAL COMMISSION, BUREAU CENTRAL DE LA COMMISSION, ELECTRO TECHNIQUE INTERNATIONALE, 1, RUEDE VEREMBE, GENEVA, SWITZERLAND.
ISO	INTERNATIONAL STANDARD ORGANISATION

**SPECIFIC REQUIREMENTS IN RMU:-**

The RMUs going to be installed in the field network will be hooked with SCADA through RTUs and Hence, RMUs used shall be compatible with SCADA.

**5.1 SERVICE CONDITIONS:**

System Particulars:

1. Nominal system voltage	11 kV and 22 kV
2. Corresponding highest system voltage	12 kV and 24
3. Frequency	50 Hz $\pm$ 3 %
4. Number of phases	3
5. Neutral Earthing	Solidly grounded
6. Fault level	20 kA for 3 sec for 11 kV RMU and 16 kA for 3 sec for 22kV RMU

The climatic conditions under which the equipment should operate satisfactory are as

under: Maximum ambient air temperature : 50 deg. C

Minimum ambient air temperature : 0 deg.C

Maximum humidity : 80% Altitude

above M.S.L. (maximum) : 1000 metres Average

annual rainfall 925 mm

Max. wind pressure : 200 Kg/m<sup>2</sup>

Seismic level (Horizontal accn.) : 0.3 g

Isoceraunic level : 50 Days per Year

Average thunder storm days : 50 days per annum

Reference ambient Temperature for temperature rise : 50 deg  
C

#### **6.00 RMU OUTDOOR METAL CLAD ENCLOSURE.**

The RMU enclosure must be a metallic; it shall follow an industrialized process of manufacturing. The RMU and combination shall be tropicalised and outdoor metal enclosed type. The RMU metal parts shall be of high thickness, high tensile steel which must be grit/short blasted, thermally sprayed with Zinc alloy, phosphate or should follow the 7 tank pre-treatment process and be subsequently painted with polyurethane based powder paint. The overall paint layer thickness shall be not less than 80 microns. The enclosure shall be of CRCA sheet of 3mm thickness or galvanized of 1.6 mm thickness. The Outer enclosure shall degree of protection IP54 (**main door closed**) and IP 41 (**Main door opened**).

The rating of enclosure shall be suitable for operation on three phase, three wire, 11 KV and

22 KV, 50 cycles, A.C. System with short-time current rating of 20KA for 3 seconds with RMU Panels.

The enclosure should have two access doors one for the operation and relay monitoring and other for the cable access. Both the doors should have the locking facility.

#### **7.00 TAKE OFF TERMINAL UNITS FOR FUTURE AUTOMATION :**

The RMU should be provided with necessary take off terminal units for future automations, located in the front/rear accesses / LV cubical of the RMU.

#### **8.00 BUS BARS:**

The Bus shall be made of EC grade tinned copper of rating 630 A and shall be covered with sleeve. The short time rating current shall be 20KA for 3 Sec for 11 kV and 16 KA for 3 Sec



earth switch. The selection of the main/earth switch lever on the fascia, which is allowed to move only if the main or earth switches is in the off position.

The manual operation of the circuit breaker shall not have an effect on the trip spring. This should only be discharged under a fault (electrical) trip; the following manual reset operation should recharge the trip spring and reset the circuit breaker mechanism in the main off position.

The circuit breaker shall be provided with self powered relay which have an electrical flag, which shall operate in the event of a fault (electrical) trip occurring. The 'tripped' flag should be an unambiguous colour differing from any other flag or mimic.

Both the circuit breaker and ring switches are operated by the same unidirectional handle. The protection on the circuit breaker shall comprise of the following components:-

- 3 NOS, 5P 10 class, protection CT's (TAPE WOUND),

- A low burden trip coil and

- **A self powered (No external DC or AC source required) IDMT protection relays (Numeric/Micro processor based) 3 x over current and ONE earth fault element shall be Definite Time type relay.** The relay should also have rechargeable batteries. The relays shall be of 1.3/3 second selectable IDMT characteristics with high set feature, the O/C element current setting variable from 20 % to 200% of CT secondary ratings and E/F element have current settings variable from 10 % to 80%. The protection curves and all other settings shall be adjustable from touch panel. The protection system should be suitable for protecting transformers of rated power from 250 KVA on wards. The relay should be housed within a pilot cable box accessible.

## **12.00 BUSHINGS:**

The RMU units are fitted with the standardized bolted type Bushings complying with IEC standards and can be replaced at site. All the bushings are the same height from the ground and are protected by a cable cover

## **13.00 CABLE BOXES:**

All the cable boxes shall be air insulated suitable for dry type cable terminations and The Cable entry can be from front / side / rear , as per the site requirements. The cable boxes at each of the two ring switches should be suitable for accepting HV cables of sizes 3c x 300/3c x 120 sq.mm and circuit breaker cable suitable up to 3c x 120 sq.mm. The cable boxes for an isolator in it's standard design should have sufficient space for connecting two cables per phase. Necessary Right angle Boot should be supplied to the cable terminations. The cable box shall be arc resistant as per IEC 62271- 200 amended uptodate. The clearances between phase to phase and phase to earth shall be as per IEC 61243 -5 amended uptodate. The



cable termination and gland arrangement shall be appropriate for type and style of cables used at the time.

#### **14.00 CABLE TESTING FACILITY:**

It shall be possible to test the cable after opening the cable boxes. The cable boxes should open only after operation of the earth switch. Thus ensuring the earthing of the cables prior to performing the cable testing with DC injection.

#### **15.00 VOLTAGE INDICATOR LAMPS AND PHASE COMPARATORS**

**The RMU shall be equipped with a voltage indication to indicate whether or not there is voltage on the cable. There should be a facility to check the synchronization of phases with the use of external device.** It shall be possible for the each of the function of the RMU to be equipped with a permanent voltage indication as per IEC 601958 to indicate whether or not there is voltage on the cables.

#### **16.00 EXTENSIBLE**

Each combination of RMU shall have the provision for extension on both sides by load break isolators / breakers in future, with suitable accessories and necessary Bus Bar. Extensible isolators and circuit breakers shall be individually housed in separate SF6 gas enclosures. Multiple devices inside single gas tank / enclosure will not be acceptable. In case of extensible circuit breakers, the Breaker should be capable of necessary short circuit operations as per IEC at 20 KA for 3 Sec for 11 KV System and 16KA for 3 sec for 22 kV system and the Breaker should have a rated current carrying capacity of 630 A.

#### **17.00 WIRING & TERMINALS:**

The wiring should be of high standard and should be able to withstand the tropical weather conditions. All the wiring and terminals (including take off terminals for future automation, DC, Control wiring), Spare terminals shall be provided by the contractor. The wiring cable must be standard single-core non-sheathed, Core marking (ferrules), stripped with non-notching tools and fitted with end sleeves, marked in accordance with the circuit diagram with printed adhesive marking strips.

The wiring should be of high standard and should be able to withstand the tropical weather conditions. All wiring shall be provided with single core multistrand copper conductor wires with P.V.C insulation.

The wiring shall be carried out using multi-strand copper conductor super flexible PVC insulated wires of 650/1100V Grade for AC Power, DC Control and CT circuits. Suitable colored wires shall be used for phase identification and interlocking type ferrules shall be provided at both ends of the wires for wire identification. Terminal should be suitably protected to eliminate sulphating. Connections and terminal should be able to withstand vibrations. The terminal blocks should be stud type for controls and disconnecting link type terminals for CT leads with suitable spring washer and lock nuts.

Flexible wires shall be used for wiring of devices on moving parts such as swinging Panels (Switch Gear) or panel doors. Panel wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals, terminal blocks and wiring gutters. The cables shall be uniformly bunched and tied by means of PVC belts and carried in a PVC carrying trough.

The position of PVC carrying trough and wires should not give any hindrance for fixing or removing relay casing, switches etc., Wire termination shall be made with solder less crimping type of tinned copper lugs. Core identification plastic ferrules marked to correspond with panel wiring diagram shall be fitted with both ends of each wire. Ferrules shall fit tightly on the wire when disconnected. The wire number shown on the wiring shall be in accordance with the IS.375.

All wires directly connected to trip circuits of breaker or devices shall be distinguished by addition of a red color unlettered ferrule.

Inter-connections to adjacent Panels (Switch Gear) shall be brought out to a separate set of Terminal blocks located near the slots or holes to be provided at the top portion of the panel. Arrangements shall be made for easy connections to adjacent Panels (Switch Gear) at site and wires for this purpose shall be provided and bunched inside the panel. The bus wire shall run at the top of the panel. Terminal block with isolating links should be provided for bus wire. At least 10% of total terminals shall be provided as spare for further connections. Wiring shall be done for all the contacts available in the relay and other equipment and brought out to the terminal blocks for spare contacts. Color code for wiring is preferable in the following colours.

Voltage supply	Red, Yellow, Blue for phase and Black for Neutral
CT circuits	similar to the above
DC circuits	Grey for both positive and negative
250V AC circuits	Red for phase and Black for neutral
Earthing	Green

The wiring shall be in accordance to the wiring diagram for proper functioning of the connected equipment. Terminal blocks shall not be less than 650V grade and shall be piece-moulded type with insulation barriers.

The terminal shall hold the wires in the tight position by bolts and nuts with lock washers. The terminal blocks shall be arranged in vertical formation at an inclined angle with sufficient space between terminal blocks for easy wiring.

The terminals are to be marked with the terminal number in accordance with the circuit

diagram and terminal diagram. The terminals should not have any function designation and are of the tension spring and plug-in type.

## **18.00 EARTHING:**

The RMU outdoor metal clad, Switch Gear, Load break isolators, Vacuum circuit breakers shall be equipped with an earth bus securely fixed along the base of the RMU.

The size of the earth bus shall be made of IEC/IS standards with **tinned copper flat for RMU and M.S. Flat for Distribution Transformer, earth spike and neutral earthing.**

Necessary terminal clamps and connectors shall be included in the scope of supply.

All metal parts of the switchgear which do not belong to main circuit and which can collect electric charges causing dangerous effect shall be connected to the earthing conductor made of **copper** having CS area of minimum 75 mm<sup>2</sup>. Each end of conductor shall be terminated by M12/equivalent quality and type of terminal for connection to earth system installation. Earth conductor location shall not obstruct access to cable terminations.

The following items are to be connected to the main earth conductor by rigid or **copper** conductors having a minimum cross section of 75 mm<sup>2</sup> (a) earthing switches (b) Cable sheath or screen (c) capacitors used in voltage control devices, if any.

The metallic cases of the relays, instruments and other panel mounted Equipment's shall be connected to the earth bus by independent copper wires of size shall be made of IEC/IS standards. The colour code of earthing wire shall be green. Earthing wires shall be connected on the terminals with suitable clamp connectors and soldering shall not be permitted.

## **19.1 ACCESSORIES & SPARES:**

The following spares and accessories shall be supplied along with the main equipments at free of costs. This shall not be included in the price schedule.

(a) Charging lever for operating load break isolators & circuit breaker of each RMU.

(b) The pressure gauges indications – 1 numbers

Provision shall be made for padlocking the load break switches/ Circuit breaker, and the earthing switches in either open or closed position with lock & master key.

## **20.00 TESTING OF EQUIPMENT & ACCESSORIES:**

**Provision for testing CTs, Relays, Breakers and Cables shall be made available. Procedure and schedule for Periodical & Annual testings of equipments, relays, etc. shall be provided by the supplier.**

### **21.1 TESTS:**

### **21.2 TYPE TESTS:**

The Tenderers should, along with the tender documents, submit copies of all Type test certificate of their make in full shape as confirming to relevant ISS/IEC of latest issue obtained from a International/National Govt. Lab/Recognized laboratory, within the last 5 (five) years from the date of offer. The list of type tests as follows:

- (1) Short time current withstand test and peak current withstand test.
- (2) Lightning Impulse voltage with-stand test
- (3) Temperature rise test.
- (4) Short Circuit current making and breaking tests.
- (5) Power frequency voltage withstand test (dry).
- (6) Capacitive current switching test confirming to IEC.
- (7) Mechanical operation test.
- (8) Measurement of the resistance of the main circuit.
- (9) Degree of protection of main tank and outer enclosure
- (10) Switch, circuit breaker, earthing switch making capacity.
- (11) Switch, circuit breaker breaking capacity.
- (12) Internal arc withstand.
- (13) Checking of partial discharge on SF6 gas tank.

The above type test certificates should accompany the drawings for the materials duly signed by the institution that has type test certificate.

### **21.3 ACCEPTANCE AND ROUTINE TESTS:**

All acceptance and routine tests as stipulated in the latest IEC- shall be carried out by the supplier in the presence of Board's representative. The supplier shall give at least 7 days advance intimation to the Board to enable them to depute their representative for witnessing the tests. The routine tests are as follows:

- (1) Conformity with drawings and diagrams,
- (2) Measurement of closing and opening speeds,
- (3) Measurement of operating torque,
- (4) Checking of filling pressure,
- (5) Checking of gas-tightness,

- (6) Dielectric testing and main circuit resistance measurement.
- (7) Power frequency voltage
- (8) Resistance test for the circuit
- (9) Mechanical operation tests.

The partial discharge shall be carried out as routine test on each and every completely assembled RMU gas tank and not on a sample basis. As this test checks and guarantees for the high insulation level and thus the complete life of switchgear.

**21.4 ADDITIONAL TESTS:**

The Board reserves the right for carrying out any other tests of a reasonable nature at the works of the supplier/laboratory or at any other recognized laboratory/research institute in addition to the above mentioned type, acceptance and routine tests at the cost of the Board to satisfy that the material complies with the intent of this specification.

**21.5 PRE-COMMISSIONING TESTS:**

All the pre-commissioning tests will be carried out in the presence of the Board testing engineer and necessary drawing manual and periodical test tools shall be arranged to be supplied.

During the above tests the contractor's representative should be present till the RMUs are put in to service.

**22 INSPECTION:**

The inspection may be carried out by the Board at any stage of manufacture. The supplier shall grant free access to Board's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the Board 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.

The supplier shall keep the Board informed in advance, about the manufacturing programme so that arrangement can be made for inspection. The Board reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. The Board has rights to inspect the supplier's premises for each and every consignment for type & routine test.

No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested / unless the same is waived by the Board in writing.

**23 QUALITY ASSURANCE PLAN:**

The bidder shall invariably furnish following information along with his offer / in case of

event of order.

(i) Statement giving list of important raw materials including but not limited to

(b) Contact material

(c) Insulation

(d) Sealing material

(e) Contactor, limit switches, etc. in control cabinet.

Name of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials in presence of Bidder's representative, copies of test certificates.

(ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.

(iii) List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections.

(iv) Special features provided in the equipment to make it maintenance free.

(v) List of testing equipment available with the Bidder for final testing of RMUs and associated combinations vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule i.e. schedule of deviations from specified test requirements. The supplier shall within 15 days from the date of receipt of Purchase Order submit following information to the Board.

a) List of raw materials as well bought out accessories and the names of sub-suppliers selected from those furnished along with offer.

**b)** Necessary test certificates of the raw material and bought out accessories.

c) Quality Assurance Plan (QAP) with hold points for Board's inspection. The quality assurance plan and hold points shall be discussed between the Board and supplier before the QAP is finalized.

The supplier shall submit the routine test certificates of bought out items and raw material, at the time of routine testing of the fully assembled breaker.

#### **24 TRAINING:**

The supplier shall give rigorous training to the engineers & staff at the site for 2 days in attending trouble shooting and maintenance, at free of cost.

#### **25 SCADA CONNECTIVITY:**

**- SPECIFIC REQUIREMENT FOR SCADA CONNECTIVITY**

**A) Following DMS requirement shall specifically be mentioned in RMU Specifications may be separate section with name “ Specific Requirement for Automation” can be added :**

1. FPI shall be provided per isolator
2. **DC control supply system should be 24VDC.**
3. Battery charger to cater load of minimum 10 motorised operation cycles (CLOSE-OPEN) in absence of battery.
4. Battery to cater load of minimum 10 motorised operation cycles (CLOSE-OPEN) in absence of battery charger. **The battery backup should be minimum of 6 Hrs**
5. Availability of MCB's for battery charger supply, RMU Motor supply & FRTU supply (Minimum 2 Amp circuit for future use of FRTU).
6. Individual control circuit of isolator/CB/BC to have point of isolation/protection.
7. Individual motor circuit of isolator/CB/BC to have point of isolation/protection.
8. RMU shall have minimum protection of IP54 for C&R section with gland plate & knock outs. Provision for control cable entry should preferably be from Right/ Left top through LV cable box & shall be independent of HV isolator/CB/BC status. It should be vermin proof.
9. Control cable gland plate shall be independent of power cable gland plate.
10. A point of earthing for control cables shall be electrically isolated from power cable earthing.
11. Ambient temperature of 50 degree C max. Allowable temperature rise of battery & battery charger above ambient 40 degree C
12. Local / Remote switch shall be provided on all the isolator & breaker panels for selection of controls
13. CT & PT terminals for all the circuit breakers only.

**B) Following is the list of I/O requirements for RMU modules. Please note that all DI & DO should be potential free contacts.**

**a) List of potential free contacts for Isolator (Terminals shall be provided):**

**Digital Indications**

1. Isolator ON --02 No. & 2 NC
2. Isolator OFF --02 No. & 2 NC
3. Isolator Earth switch Status (ON/OFF)

4. FPI Operated
5. LOCAL/REMOTE switch position

**List of commands**

1. Isolator Close
2. Isolator Open
3. FPI reset

- b) List of potential free Contacts for Circuit Breakers / Bus Coupler (Terminals shall be provided)**

**Digital Indications**

1. Circuit Breaker ON
2. Circuit Breaker OFF
3. Auto Trip
4. LOCAL/REMOTE switch position

**List of commands**

1. Circuit Breaker Close
2. Circuit Breaker Open

- c) Requirement of Multifunction Meters (MFMs)**

Terminals shall be provided for CT and PT Connections

Space may be provided for MFM mounting inside control panel

**26 DOCUMENTATION and DRAWINGS:**

All drawings shall conform to relevant International Standards Organization (ISO) Specification. All drawings shall be in ink and suitable for microfilming.

The tenderer shall submit along with his tender dimensional general arrangement drawings of the equipments, illustrative and descriptive literature in triplicate for various items in the RMUs which are all essentially required for future automation.

- i) Schematic diagram of the RMU panel
- ii) Instruction manuals
- iii) Catalogues of spares recommended with drawing to indicate each items of spares
- iv) List of spares and special tools recommended by the supplier.
- v) Copies of Type Test Certificates as per latest IS/IEC.



- vi) Drawings of equipments, relays, control wiring circuit, etc.
- vii) Foundation drawings of RMU and D.T.Structure.
- viii) Dimensional drawings of each material used for item Vii.
- ix) Actual single line diagram of RMU/RMUs with or without Extra combinations shall be made displayed on the front portion of the RMU so as to carry out the operations easily.

The following should be supplied to each consignee circle along with the initial supply of the equipments ordered. 2 copies of printed and bound volumes of operation, maintenance and erection manuals in English along with the copies of approved drawings and type test reports etc. 2 sets of the manuals as above shall be supplied to the Chief Engineer/Distribution. A soft copy of the all Technical and Drawing furnished in a CD.

## **27 NAME PLATE:**

Each RMU and its associated equipments shall be provided with a nameplate legible and indelibly marked with at least the following information.

- (a) Name of manufacturer
- (b) Type, design and serial number
- (c) Rated voltage and current
- (d) Rated frequency
- (e) Rated symmetrical breaking capacity
- (f) Rated making capacity
- (g) Rated short time current and its duration
- (h) Purchase Order number and date
- (i) Month and Year of supply
- (j) Rated lightning impulse withstand voltage
- (k) Feeder name (Incoming and Out going), DTs Structure name, 11000Volts
- (l) Dangers etc.

### **NOTE:**

- i) The word rated need not appear on the name plate. Recognized abbreviations may be used to express the above particulars.
- ii) Whether the circuit breaker is fitted with closing / tripping devices necessitating an auxiliary supply shall be stated either on the circuit breaker name plate or any

other acceptable position.

**28 FAULT PASSAGE INDICATORS (FPI):**

These shall facilitate quick detection of faulty section of line. The fault indication may be on the basis of monitoring fault current flow through the device. The unit should be self-contained requiring no auxiliary power supply. The FPI shall be integral part of RMU. The FPI shall have **LCD/LED display**, automatic reset facility. The sensors to be bushing mounted. FPI shall be provided per isolator

**29 TROPICALISATION:**

Due regard should be given to the climatic conditions under which the equipment is to work. Ambient temperature normally varies between 0°C and 50°C. The climate is humid and rapid variations occur, relative humidity between 60% and 90% being frequently recorded, but these values generally correspond to the lower ambient temperatures. The equipment should also be designed to prevent ingress of vermin, accidental contact with live parts and to minimize the ingress of dust and dirt. The use of materials which may be liable to attack by termites and other insects should be avoided.

**30 PROTOTYPE SAMPLE:**

The successful bidder should manufacture 3 Nos of Prototype RMUs as per the specification and keep ready at their works for the purpose of sample inspection and testing. The MSEDCL at their option may send a team of Engineers to the works. Prior intimation of this inspection may not be given to the bidder.

**31 MOTORISATION:**

All the functions within the RMU i.e Isolators / Breakers should be fitted with motor mechanism and closing coil making it suitable to make it on from remote.

Control Supply and Auxiliaries: Following Auxiliaries has to be considered other):- i.

Shunt Trip Coil -24 V DC for Isolators and Breakers.

- ii. Closing Coil – 24 VDC
- iii. Motor Mechanism – 24 VDC
- iv. 2 NO + 2 NC – Potential free auxiliary contacts for breakers / isolators
- v. Auxiliary Power supply should be – 24 VDC
- vi. Battery & Battery Charger with the battery backup of at least 6 Hour
- vii. Local / Remote Switch for breaker and isolators

**32 METERING:**

Separate Metering Module Consisting of Bus connected PTs and metering CTs to be provided for VCB function along with provision of installing Multifunction meter to be

provided. The PTs and CTs provided shall be made up of epoxy cast resin Ring Core type with an accuracy class of 0.5S & The CT of 5 Amp. Secondary. The CT ratio shall as per transformer rating. The metering is required only in breaker functions.

### 33 SCHEDULES

33.1 The Tenderer shall fill in the following schedule's which is part and parcel of the tender specifications and offer. If the Schedules are not submitted duly filled in with the offer, the offer shall be liable for rejection.

Schedule 'A' (Annexure 1 to 6) ..... Guaranteed and technical Particulars

Schedule 'B' ..... Schedule of Tenderer's Experience

33.2 Any Additional information may be furnished separately by the tenderer, if necessary.

### 34 GUARANTEED TECHNICAL PARTICULARS:

The Bidder should fill up the details in schedule A – 'Guaranteed technical Particulars and the statement such as "as per drawing enclosed", "As per MSEDCL requirement", "as per IS", "as per specification" etc shall be considered as details not furnished and such offers will be rejected.

### 35 TECHNICAL SPECIFICATION FOR RMU A) 11 KV

#### RMU

##### I. 11KV Bus Bar

Current Carrying Capacity : **630 Amps.**

*Short time rating current for 3 secs. : 20 KA*

*Insulation of bus bar : SF6*

*Bus bar connections : Anti-oxide grease*

##### II. Parameters for Circuit Breaker and Load break isolators

Type : Metal enclosed

No of Phases 3

No. of poles 3

Rated voltage : 12 KV

Operating voltage : 11 KV (+10% to -20%)

Rated lightning impulse withstand voltage : **75 KV**

Rated power frequency withstand voltage : 28 KV

Insulating gas : SF6

Rated filling level for insulation	: As per IEC.
Operating SF6 Gas pressure	: 0.5 bar G at 20 deg C
Max. Permissible site altitude at the above gas pressures	: 1000m
(The operating pressure has to be adjusted for greater altitudes)	
Isolating distance between ON and OFF position in isolator	: <u>As per IEC standard.</u>
Rated short time current	: 20 KA.
Rated short time	: 3s Rated
peak withstand current	: 50 KA. <b>Maximum</b>
<b>temperature rise over ambient 50 deg C</b>	<b>: 55 deg C.</b>
No of operations in Short circuit	: 15Nos (minimum)
Operating mechanism	: Circuit breaker with spring assisted anti reflex mechanism.
Rated current (Bus)	: <b>630 A</b> Rated
current (breaker)	: <b>630 A</b> Circuit
Breaker interrupter	: <b>SF6 / VCB</b> Rated
frequency	: <b>50 Hz</b>
Rated operating sequence	: <b>O-3min- CO</b> as per IEC standard

**Number of mechanical/Remote operations for earthing**

**& Ring switches & Number of mechanical / remote operations for circuit breakers**

**B) 22 KV RMU**

**I. 22 KV Bus Bar**

Current Carrying Capacity : **630 Amps**. Short time rating current for 3

secs. : 16 KA Insulation of bus bar : SF6

Bus bar connections : Anti-oxide grease

**II. Parameters for CIRCUIT BREAKER and load break isolators**

**As per IE60298**

Type	: Metal enclosed
No of Phases	3
No. of poles	3

Rated voltage	: 24 KV
Operating voltage	: 22 KV (+10% to –20%)
Rated lightning impulse withstand voltage	: <b>125 kV Peak</b>
Rated power frequency withstand voltage	: 50 KV
Insulating gas	: SF6
Rated filling level for insulation	: As per IEC.
Operating SF6 Gas pressure	: 0.5 bar G at 20 deg C
Max. Permissible site altitude at the above gas pressures	: 1000m
(The operating pressure has to be adjusted for greater altitudes)	
Isolating distance between ON and OFF position in isolator: 80 mm (min).	
Rated short time current	: 16 KA.
Rated short time	: 3s <b>Maximum</b>
<b>temperature rise over ambient 50 deg C</b>	: <b>55 deg C.</b> Rated peak
withstand current	: 50 KA.
No of operations in Short circuit	: 15Nos (minimum)
Operating mechanism: Circuit breaker with spring assisted anti reflex	
mechanism. Rated current (Bus)	: 630 A
Rated current (breaker)	: <b>630 A (Depending on Transformer rating)</b>
Circuit Breaker interrupter	: <b>SF6/VCB</b>
Rated frequency	: <b>50 Hz</b>
Rated operating sequence	: <b>O-3min-CO as per IEC Standard</b>
Maximum Opening time on No Load condition (msec)	: 40-60 msec
Opening & closing time under SF6 gas loss or vacuum loss condition: 40-60 msec	
<b>Number of mechanical/Remote operations for earthing</b>	<b>As per IEC</b>
<b>&amp; Ring switches &amp; Number of mechanical / remote operations for circuit breakers</b>	<b>60298</b>

### III. PRINCIPAL FEATURES

S. No	DESCRIPTION	DT breaker
1	Circuit label	Yes
2	Mimic diagram	Yes
3	Supply voltage indication	Yes
4	Current Transformer	Yes
5	Self Powered based Microprocessor based IDMT Relay (3OL)/EL	Yes
6	Anti – Reflexing Relay	Yes
7	<u>Mechanical</u> Interlock to defeat the operation of the line side earthing when the line side isolator is	Yes
8	<u>Mechanical Interlock to ensure that any live part of RMU should not get earthed.</u>	Yes
9	Breaker ON/OFF indication	Yes
10	Spring Charge indication/Spring assisted mechanism.	Yes
11	Fault Tripping indication	Yes
12	Bus bar end caps	Yes
13	Whether the SF6 gas pressure gauge indicator and filling arrangement.	Yes
14	Whether the spring assisted mechanism with operating handle for ON/OFF.	Yes
15	Whether the earth positions with arrangement for padlocking in each position and independent manual operation with mechanically operated indicator are provided	Yes
16	RMUs are provided with necessary take off terminals for future automation.	Yes

**IV. Earthing switch for 11 KV Line side Isolation and DT**

Rated short time current : 20 KA.  
Rated short time : 3s Rated  
peak withstand current : 50 KA

Interlocking facility: 1) Between 11 KV Line side isolator 'ON" & Earthing.  
2) Between 11 KV DT side breaker on close condition & Earthing.

**V. Earthing switch for 22 KV Line side Isolation and DT**

Rated short time current : 16 KA.  
Rated short time : 3s  
Rated peak withstand current : 50 KA

Interlocking facility: 1) Between 11 KV Line side isolator 'ON" & Earthing.  
2) Between 11 KV DT side breaker on close condition & Earthing.

***VI. Current Transformers for breaker***

CT Type	Tape wound
---------	------------

CT Description	The CTs of DT breaker shall be suitable for sensing the minimum primary variable as per Transformer rating and standardized ratio i.e. 5/5, 10/5, 25/5, 50/5, 100/5,  etc. and the secondary current for the CT is 5 A. The CT shall be housed in outside SF6 chamber for testing and Maintenance
Accuracy Class	class 5P10 for protection and 0.5S for metering.
Rated burden	Suitable for self powered relay



**SECTION – VI / ANNEXURE – 1**

**GUARANTEED TECHNICAL PARTICULARS FOR OUTDOOR type 11kV /22 kV MOTORISED  
RING MAIN UNIT**

01.	Manufacturer's Name and Country of origin	
02.	Manufacturer's Design / Type ref/Model.	
03.	Material used for making the body of the enclosure	
04.	Standards of manufacturing	
05.	Whether painting for RMU metal enclosure is done as per high standards.	
06.	Whether the enclosure is fire resistive, anti-corrosive	
07.	Whether the RMU metal clad is provided with sufficient space for integration of  b) Minimum 2 numbers load break isolators and 1 number SF6/Vacuum Circuit breaker.  e) Sufficient space for inspection, testing, etc f) Earthing arrangements  g) Terminal output points for future automation  h) Sufficient arrangement for future extension with Load break isolators/Breakers  i) Space for motorization of Load break isolators/Breakers in future.	
08.	Maximum temperature with stand of enclosure.	
09.	Spacing between live part to Earth	

10.	Whether the enclosure are designed to withstand the in all weather conditions (Seashore area, Chemical industries polluted	
11.	Period of guarantee of the RMU enclosure.	
12.	Over all dimensions of the RMU enclosure (L x B x H)	
13.	Gauge of the Material used for the fabrication of the RMU enclosure	
14.	Whether the RMU enclosure is manufactured as per IEC/IS standards to hold SF6 gas without leakage.	
15.	Whether the RMU enclosure made provision for sensors for temperature compensated pressure measurement in the relevant gas compartment to monitor the pressure of SF6 gas.	
16.	Whether the RMU enclosure is sealed pressure system.	
17.	Weight of RMU complete with operating mechanism.	
18.	RMUs are provided with necessary take off terminals	
19	Whether the gas chamber is made of stainless steel/Metalized Cast Resin	

## SECTION – VI/ANNEXURE – 2

### SCHEDULE OF GUARANTEED PARTICULARS FOR DT CIRCUIT BREAKER

01.	Manufacturer's Name and Country of origin	
02.	Manufacturer's Design / Type ref/Model.	
03.	Material used for making the body of the breaker	
04.	Standards of manufacturing	
05.	Whether the breakers are manufactured as per IEC/IS standards	
06.	Maximum temperature with stand of the breakers	
07.	1)Spacing between live part to Earth inside the breaker 2)Spacing between poles	
08.	Period of guarantee of the breaker	
09.	Rated frequency	
10.	Rated voltage	
11.	Highest system voltage	
12.	Rated current	
13.	Short time current rating with duration	
14.	Certificate or report of short circuit type test	
15.	Rated operating duty cycle	
16.	Short circuit breaking current (a)Symmetrical	

	(b) Symmetrical at rated voltage © Asymmetrical at rated voltage (i) Per Phase (ii) Average (d) DC Component	
17.	Arcing time (At rated breaking current) in ms.	
18.	Opening time	
19.	Total break time in milli sec. (a) At 10% rated interrupting capacity (b) At rated interrupting capacity	
20.	Breaking Current (a) Rated out of phase current (b) Rated cable charging current (c) Rated kilometric fault level (d) Rated capacitor breaking current	
21.	Make time in ms.	
22.	Maximum temperature rise over ambient (a) Main contacts Terminals	
23.	Rated restriking voltage at 100% and 50% rated capacity. (a) Amplitude factor (b) Phase factor © Natural frequency (d) R.R.R.V. (Volts/micro sec.)	
24.	Dry 1 minute power frequency withstand test voltage (a) Between line terminal and earth KV RMS (b) Between terminals with breaker contacts open KV RMS.	
25.	1.2/50 full wave impulse withstand test voltage	

	(a)Between line terminal and earth KVp. (b)Between terminals with breaker contacts open KVp.	
26.	SF6 /VCB interrupter make	
27.	Contact separation distance	
28.	Type of main contacts	
29.	Contact pressure	
30.	Contact resistance	
31.	Life of the interrupter (in number of operations)	
32.	(i)Tripping at rated current (ii)Tripping at maximum fault current. (Allowable maximum erosion 3 mm) (iii)Mechanical operations.	
33.	Details of main contacts making contact with the breaker truck with the panel	
34.	Control circuit voltage AC/DC.	
35.	Whether trip free or not	
36.	Whether all the interlocks provided	

### SECTION – VI/ANNEXURE – 3

#### SCHEDULE OF GUARANTEED PARTICULARS FOR LOAD BREAK ISOLATORS & EARTHING ARRANGEMENTS

SL.	DESCRIPTION	ISOLATORS	EARTHING SWITCH FOR DT & ISOLATOR
01.	Manufacturer's Name and Country of origin		
02.	Manufacturer's Design / Type ref/Model.		
03.	Material used for making the body of the isolators .		
04.	Standards of manufacturing		
05.	Whether the isolators & earth positions are manufactured as per IEC/IS standards		
06.	Maximum temperature with stand of the isolators & earth switches		
07.	1) Spacing between live part to Earth 2) Spacing between fixed and moving contacts in the open position.		
08.	Period of guarantee of the isolators		
09.	Rated frequency		
10.	Rated voltage		
11.	Highest system voltage		

12.	Rated current		
13.	Short time current rating with duration		
14.	Certificate or report of short circuit type test		
15.	Rated operating duty cycle		
16.	Short circuit breaking current		
17.	Arcing time (At rated breaking current) in ms.		
18.	Opening time		
19	Whether all the <u>Mechanical interlocks</u> provided.		
20	Whether Sufficient arrangements are made to operate the isolators through SCADA in future, also to be ensured for provision of space for accommodation of motor in future		
21	Fault passage indicator 1)Type/Model 2)Self powered Yes/No 3)Current readings 4)Fault currents 5)Phase currents		

## SECTION – VI/ANNEXURE – 4

### SCHEDULE OF GUARANTEED PARTICULARS FOR CURRENT TRANSFORMERS

01.	Manufacturer's Name and country of origin	Required
02.	Manufacturer's design ref / model	Bidder to specify
03.	Applicable Standards	
04.	1)Type of CT 2)Ratio	
05.	Rated Primary current	
06.	Rated secondary current	
07.	Rated frequency	
08.	Transformation ratio	
09.	Number of cores	
10.	Rated output (a) For Core-I	
11.	Class of insulation	
12.	Class of accuracy For Protection	
13.	Short time current rating and its duration	
14.	Secondary resistance at 70 Deg °C	
15.	Continuous over load (percentage)	



16.	One minute power frequency dry withstand voltage	
17.	1.2/50 micro sec. impulse withstand test voltage	
18.	One minute power frequency withstand test voltage on secondary	
19.	Instrument safety factor	
20.	Type of primary winding	
21.	Literature/leaflets pamphlets about the current transformer offered	
22.	Period of guarantee	

## SECTION – VI/ANNEXURE – 5

### SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR SELF POWERED MICRO PROCESSOR BASED NUMERICAL RELAYS

01.	Manufacturer's Name and Country of origin		
02.	Manufacturer's design / Ref. Type		
03.	Applicable Standards		
04.	Current Setting range for (a)Over current relay (b)Earth fault Element	IDMT	
		Definite Time	
05.	Whether the relay has the in-built facilities of IDMT, OL, EL		
06.	Details of IDMT Characteristics		
07.	Accuracy for different settings and limits of errors		
08.	Whether Alpha numeric / LED display		
09.	Whether compatible for 1 A CT Secondary		
10.	Whether draw out type		
11.	Types of case		
12.	Reset time		
13.	Burden of relay		
14.	Maximum and Minimum, operating ambient air temp.		
15.	Whether technical literature pamphlets about the relay offered.		
16.	Period of guarantee.		
17.	Certificate of Proof for Electro Magnetic Interference.		

**SECTION VI/  
ANNEXURE – 6**

**SCHEDULE OF GUARANTEED TECHNICAL PARTICULARS FOR DRAWINGS.**

The contractor shall supply the following drawings.

01.	RMU	
02.	General arrangement drawing of panels in station	
03.	Engineering drawing for each panel including foundation details	
04.	Wiring schedule	
05.	Terminal block arrangement drawing	
06.	Descriptive operation and maintenance manual for individual items such as relays, meters, switches recorders etc.	
07.	Any other drawing required for complete understanding of the equipments supplied.	

Three copies of the drawings shall be submitted to this office for approval.

Six copies of the approved drawings and pamphlets shall be supplied to this office. One copy of the approved drawing and pamphlets for the panels pertaining to each substation shall be supplied to the field engineers. These drawings and pamphlets shall be supplied in a neat bound book suitable for easy reading and frequent use. In addition reproduceable tracing of the various drawings shall be supplied to this office.

## Annexure-IV

### i. Form of Joint Bidding Agreement

*(To be executed in India on a non judicial Stamp paper of appropriate value)*

THIS JOINT BIDDING AGREEMENT (the “**Agreement**”) is entered into on this the ..... day of ..... 20...

#### AMONGST

1. {.....}<sup>1</sup> and having its registered office at ..... (hereinafter referred to as the “**First Part**” which expression shall, unless repugnant to the context include its successors and permitted assigns)

#### AND

2. {.....}<sup>19</sup> and having its registered office at ..... (Hereinafter referred to as the “**Second Part**” which expression shall, unless repugnant to the context include its successors and permitted assigns)

The above mentioned parties of the FIRST and SECOND PART are collectively referred to as the “**Parties**” and each is individually referred to as a “**Party**”

#### WHEREAS,

- (A) NAGPUR METRO RAIL CORPORATION LIMITED, represented by the ..... and having its principal offices at ..... (hereinafter referred to as the “**Employer**” which expression shall, unless repugnant to the context or meaning thereof, include its administrators, successors and assigns) has invited bids (the “**Bids**”) by its ITB No. .... dated ..... (the “**ITB**”) for \_\_\_\_\_ (Hereinafter referred to as the “**Employer**”).
- (B) The Parties are interested in jointly bidding for the Project as members of a Consortium / JV and in accordance with the terms and conditions of the ITB document and other bid documents in respect of the Project, and
- (C) It is a necessary condition under the ITB document that the members of the Consortium shall enter into a Joint Bidding Agreement and furnish a copy thereof with the Bid.

**NOW IT IS HEREBY AGREED as follows:**

#### 1. Definitions and Interpretations

<sup>1</sup> The members of the JV/Consortium to fill in their name and the relevant law and the jurisdiction of incorporation.

In this Agreement, the capitalised terms shall, unless the context otherwise requires, have the meaning ascribed thereto under the ITB.

## **2. Consortium**

2.1 The Parties do hereby irrevocably constitute a consortium (the “**Consortium**”) for the purposes of jointly participating in the bidding process for the Project.

2.2 The Parties hereby undertake to participate in the bidding process only through this Consortium and not individually and/ or through any other consortium constituted for this Project, either directly or indirectly.

## **3. Covenants of their Associates**

The Parties hereby undertake that in the event the Consortium is declared the selected Bidder and awarded the Project, it shall enter into a Contract Agreement with the Employer and for performing all its obligations as the Contractor in terms of the Contract Agreement for the Project.

## **4. Role of the Parties**

The Parties hereby undertake to perform the roles and responsibilities as described below:

- (a) Party of the First Part shall be the Lead member of the Consortium and shall have the power of attorney from all Parties for conducting all business for and on behalf of the Consortium under the Contract Agreement;
- (b) Party of the Second Part shall be {\_\_\_\_\_};

## **5. Joint and Several Liability**

The Parties do hereby undertake to be jointly and severally responsible for all obligations and liabilities relating to the Project and in accordance with the terms of the Contract Agreement.

## **6. Participation in the Consortium / JV**

6.1 The Parties agree that the proportion of shareholding among the Parties in the Consortium / JV shall be as follows:

First Party:

Second Party:

## **7. Representation of the Parties**

Each Party represents to the other Parties as of the date of this Agreement that:

- (a) Such Party is duly organized, validly existing and in good standing under the laws of its incorporation and has all requisite power and authority to enter into this Agreement;

- (b) The execution, delivery and performance by such Party of this Agreement has been authorized by all necessary and appropriate corporate or governmental action and a copy of the extract of the charter documents and board resolution/ power of attorney in favour of the person executing this Agreement for the delegation of power and authority to execute this Agreement on behalf of the Consortium Member is annexed to this Agreement, and will not, to the best of its knowledge:
- (i) require any consent or approval not already obtained;
  - (ii) violate any applicable law presently in effect and having applicability to it;
  - (iii) violate the memorandum and articles of association, by-laws or other applicable organizational documents thereof;
  - (iv) violate any clearance, permit, concession, grant, license or other governmental authorization, approval, judgment, order or decree or any mortgage agreement, indenture or any other instrument to which such Party is a party or by which such Party or any of its properties or assets are bound or that is otherwise applicable to such Party; or
  - (v) create or impose any liens, mortgages, pledges, claims, security interests, charges or encumbrances or obligations to create a lien, charge, pledge, security interest, encumbrances or mortgage in or on the property of such Party, except for encumbrances that would not, individually or in the aggregate, have a material adverse effect on the financial condition or prospects or business of such Party so as to prevent such Party from fulfilling its obligations under this Agreement;
- (c) this Agreement is the legal and binding obligation of such Party, enforceable in accordance with its terms against it; and
- (d) there is no litigation pending or, to the best of such Party's knowledge, threatened to which it or any of its affiliates is a party that presently affects or which would have a material adverse effect on the financial condition or prospects or business of such Party in the fulfillment of its obligations under this Agreement.

## **8. Termination**

This Agreement shall be effective from the date hereof and shall continue in full force and effect until the completion of the Project is achieved under and in accordance with the Contract Agreement, in case the Project is awarded to the Consortium. However, in case the Consortium does not get selected for award of the Project, the Agreement will stand terminated upon return of the Bid Security by the Employer to the Bidder, as the case may be.

## **9. Miscellaneous**

9.1 This Joint Bidding Agreement shall be governed by laws of {India}.

9.2 The Parties acknowledge and accept that this Agreement shall not be amended by the Parties without the prior written consent of the Employer.

IN WITNESS WHEREOF THE PARTIES ABOVE NAMED HAVE EXECUTED AND DELIVERED THIS AGREEMENT AS OF THE DATE FIRST ABOVE WRITTEN.

SIGNED, SEALED AND DELIVERED

SIGNED, SEALED AND DELIVERED

For and on behalf of

LEAD MEMBER by:

SECOND PART

(Signature)

(Signature)

(Name)

(Name)

(Designation)

(Designation)

(Address)

(Address)

*Notes:*

1. The mode of the execution of the Joint Bidding Agreement should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.
2. Each Joint Bidding Agreement should attach a copy of the extract of the charter documents and documents such as resolution / power of attorney in favour of the person executing this Agreement for the delegation of power and authority to execute this Agreement on behalf of the Consortium Member.



**ii. Form of Legal Capacity / Power of  
Attorney**

*(Refer [ITB20.2](#))*

*(To be forwarded on the letterhead of the Bidder/ Lead Member of Consortium)*

Ref. Date:

To,

\*\*\*\*\*

\*\*\*\*\*

Dear Sir,

We hereby confirm that we/ our members in the Consortium (constitution of which has been described in the bid) satisfy the terms and conditions laid out in the ITB document.

We have agreed that ..... (insert member's name) will act as the Lead Member of our consortium.\*

We have agreed that ..... (insert individual's name) will act as our representative/ will act as the representative of the consortium on its behalf\* and has been duly authorized to submit the bid. Further, the authorised signatory is vested with requisite powers to furnish such letter and authenticate the same.

Thanking you,

Yours faithfully,

(Signature, name and designation of the authorised signatory)

For and on behalf of.....

*\*Please strike out whichever is not applicable.*

### **iii. Power of Attorney for signing of Bid**

Know all men by these presents, We..... (name of the firm and address of the registered office) do hereby irrevocably constitute, nominate, appoint and authorise Mr/ Ms (name), ..... son/daughter/wife of ..... and presently residing at ....., who is presently employed with us/ the Lead Member of our Consortium and holding the position of ....., as our true and lawful attorney (hereinafter referred to as the "Attorney") to do in our name and on our behalf, all such acts, deeds and things as are necessary or required in connection with or incidental to submission of our bid for the \*\*\*\*\* Project proposed by the \*\*\*\*\* (the "Employer") including but not limited to signing and submission of all applications, bids and other documents and writings, participate in pre-bid meetings and other conferences and providing information/ responses to the Employer, representing us in all matters before the Employer, signing and execution of all contracts including the Contract Agreement and undertakings consequent to acceptance of our bid, and generally dealing with the Employer in all matters in connection with or relating to or arising out of our bid for the said Project and/ or upon award thereof to us and/or till the entering into of the Contract Agreement with the Employer.

AND we hereby agree to ratify and confirm and do hereby ratify and confirm all acts, deeds and things done or caused to be done by our said Attorney pursuant to and in exercise of the powers conferred by this Power of Attorney and that all acts, deeds and things done by our said Attorney in exercise of the powers hereby conferred shall and shall always be deemed to have been done by us.

IN WITNESS WHEREOF WE, ....., THE ABOVE NAMED PRINCIPAL HAVE EXECUTED THIS POWER OF ATTORNEY ON THIS ..... DAY OF ..... 2014.

Signature of the Authorized Representative:

Initial of the Authorized Representative:

Signed before me and the signature is attested

For .....

(Signature, name, designation and address)

Witnesses:

1.

(Notarised)

2.

Accepted

.....

(Signature)

(Name, Title and Address of the Attorney)

*Notes:*

- *The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.*
- *Wherever required, the Bidder should submit for verification the extract of the charter documents and documents such as a board or shareholders' resolution/ power of attorney in favour of the person executing this Power of Attorney for the delegation of power hereunder on behalf of the Bidder.*
- *For a Power of Attorney executed and issued overseas, the document will also have to be legalised by the Indian Embassy and notarised in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by bidder/members of the Consortium from countries that have signed the Hague Legislation Convention 1961 are not required to be legalised by the Indian Embassy if it carries a conforming Appostille certificate.*

## **iv. Power of Attorney for Lead Member of Consortium**

Whereas the \*\*\*\*\* (“the Employer”) has invited applications from interested parties for the \*\*\*\*\* Project (the “Project”).

Whereas, ....., ....., ..... and ..... (collectively the “Consortium”) being Members of the Consortium are interested in bidding for the Project in accordance with the terms and conditions of the Instruction to Bidders (ITB) and other connected documents in respect of the Project, and

Whereas, it is necessary for the Members of the Consortium to designate one of them as the Lead Member with all necessary power and authority to do for and on behalf of the Consortium, all acts, deeds and things as may be necessary in connection with the Consortium’s bid for the Project and its execution.

**NOW THEREFORE KNOW ALL MEN BY THESE PRESENTS**

We, ..... having our registered office at ....., M/s. .... having our registered office at ....., (hereinafter collectively referred to as the “Principals”) do hereby irrevocably designate, nominate, constitute, appoint and authorise M/S ..... having its registered office at ....., being one of the Members of the Consortium, as the Lead Member and true and lawful attorney of the Consortium (hereinafter referred to as the “Attorney”). We hereby irrevocably authorise the Attorney (with power to sub-delegate) to conduct all business for and on behalf of the Consortium and any one of us during the bidding process and, in the event the Consortium is awarded the concession/contract, during the execution of the Project and in this regard, to do on our behalf and on behalf of the Consortium, all or any of such acts, deeds or things as are necessary or required or incidental to the pre-qualification of the Consortium and submission of its bid for the Project, including but not limited to signing and submission of all applications, bids and other documents and writings, participate in bidders and other conferences, respond to queries, submit information/ documents, sign and execute contracts and undertakings consequent to acceptance of the bid of the Consortium and generally to represent the Consortium in all its dealings with the Employer in all matters in connection with or relating to or arising out of the Consortium’s bid for the Project and/or upon award thereof for all obligations and liabilities relating to the Project and in accordance with the terms of the Contract Agreement.

AND hereby agree to ratify and confirm and do hereby ratify and confirm all acts, deeds and things done or caused to be done by our said Attorney pursuant to and in exercise of the powers conferred by this Power of Attorney and that all acts, deeds and things done by our said Attorney in exercise of the powers hereby conferred shall and shall always be deemed to have been done by us/ Consortium.

IN WITNESS WHEREOF WE THE PRINCIPALS ABOVE NAMED HAVE EXECUTED THIS POWER OF ATTORNEY ON THIS ..... DAY OF .....

2....

For .....  
(Signature)  
.....  
(Name & Title)

For .....  
(Signature)  
.....  
(Name & Title)

Accepted:

Witnesses:

1.

2.

.....

(Executants)

(To be executed by all the Members of the Consortium)

Notes:

- *The mode of execution of the Power of Attorney should be in accordance with the procedure, if any, laid down by the applicable law and the charter documents of the executant(s) and when it is so required, the same should be under common seal affixed in accordance with the required procedure.*
- *Also, wherever required, the Bidder should submit for verification the extract of the charter documents and documents such as a board or shareholders' resolution/ power of attorney in favour of the person executing this Power of Attorney for the delegation of power hereunder on behalf of the Bidder.*
- *For a Power of Attorney executed and issued overseas, the document will also have to be legalised by the Indian Embassy and notarised in the jurisdiction where the Power of Attorney is being issued. However, the Power of Attorney provided by Applicants from countries that have signed the Hague Legislation Convention 1961 are not required to be legalised by the Indian Embassy if it carries a conforming Appostille certificate.*

## **Tender Index**

The Bidder shall include with his Tender an index which cross refers all of the Employer's tender requirements elaborated in Bid Documents to all the individual sections within Technical Package and Financial Package which the Bidder intends to be the responses to each and every one of those requirements.

The Bid submitted must be clearly presented, all pages numbered and aid out in a logical sequence with main and subheadings to facilitate evaluation.