Amendment-VIII dated 03.10.2025 to the RFP Documents for selection of Bidder as Transmission Service Provider to establish Intra-State Transmission project namely "Evacuation Scheme for 2000MW solar park at Ryapte Village, Tumkur District" to be implemented through tariff based competitive bidding process.

<table>
<tr><th>Sl. No</th><th>Clause No.</th><th>Existing Provisions</th><th>New/ Revised/ Modified Provision</th></tr>
<tr><td>1.</td><td>RFP:

Scope of Work, Section 1: Clause 1.2

TSA:

Schedule-1</td><td>
<table>
<tr><th>Sl. No.</th><th>Scope of the Transmission Scheme</th><th>Scheduled COD in months from Effective Date</th></tr>
<tr><td>1.</td><td>…..</td><td>……</td></tr>
<tr><td>2.</td><td>…</td><td></td></tr>
<tr><td>3.</td><td>Establishing 3X500 MVA, 400/220kV GIS sub-station at Doddathaggalli (Near Hosakote) along with 2x125 MVAr, 400 kV Bus Reactors.

• 400/220 kV ICTs: 3 no.
• 400 kV ICT Bays: 3 Nos
• 400 kV Line bays : 4 Nos
• 125 MVAr, 420 kV Bus reactor – 2 No
• 400 kV Bus reactor bay: 2 Nos
• 220 kV ICT Bays: 3 Nos
• <u>220 kV Line bays: 8 Nos.</u>
• 220 kV BC bay – 1 No
• 400 kv Bus PT bay- 2 Nos
• 220 kv Bus PT bay- 2 Nos

Future Provision:
• 400 kV line bays – 4 Nos.
• 400/220 kV ICTs - 2 Nos.
• 400 kV ICT bays - 2 Nos
• 400 kV Bus Reactor: 2 Nos.
• 400 kV Bus Reactor bays: 2 Nos.
• 220 kV ICT Bays: 2 Nos.
• 220 kV Line bays: 4 Nos</td><td></td></tr>
<tr><td>4.</td><td>…</td><td></td></tr>
</table>
</td><td>
<table>
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• 220 kV BC bay – 1 No
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Future Provision:
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Sl. No	Clause No.	Existing Provisions	New/ Revised/ Modified Provision
		5. **220 kV DC line with Twin Zebra conductor from proposed 400/220 kV Doddathagalli sub-station to existing 220/66kV Malur sub-station with 2 No.s of TB at Malur S/s.** 6. **220kV DC line with Twin Zebra conductor/UG cable (2500 sqmm)** from proposed 400/220 kV Doddathagalli sub-station to 220kV Ekarajapura sub-station with 2 No.s of AIS TB at Ekarajapura S/s with rearrangement/Shifting of existing Bus PT bay 7. **220kV DC line with Twin Zebra conductor/UG cable (2500 sqmm)** from proposed 400/220 kV Doddathagalli sub-station to proposed 220kV Hosakote New sub-station. 8. **220kV DC line with Twin Zebra conductor/ UG Cable (2500 sqmm)** from proposed 400/220kV Doddathagalli to Sarjapura AIS S/s with 2 No.s of outdoor GIS TB at Sarjapura S/s by extending existing AIS bus bar along with AIS isolator **Note:** 1…. 2…. 3. TSP to pay onetime charges (arrived as per KPTCL norms based on the prevailing guidance value) for use of land and common	5. **Stands deleted** 6. **220kV DC line with Single Zebra and partial 2 runs of 1200 Sq.mm UG cable (based on field conditions)** from proposed 400/220 kV Doddathagalli sub-station to 220kV Ekarajapura sub-station with 2 No.s of AIS TB at Ekarajapura S/s with rearrangement/Shifting of existing Bus PT bay **Note: The Tower design shall be suitable for TWIN Zebra.** 7. **220kV DC line with partial AAAC Moose and partial 2 runs of 1200 Sq.mm UG cable (based on field conditions)**, from proposed 400/220 kV Doddathagalli sub-station to proposed 220kV Hosakote New sub-station. 8. **220kV DC line with Single Zebra and partial 2 runs of 1200 Sq.mm UG cable (based on field conditions)** from proposed 400/220kV Doddathagalli to Sarjapura AIS S/s with 2 No.s of outdoor GIS TB at Sarjapura S/s by extending existing AIS bus bar along with AIS isolator **Note: The Tower design shall be suitable for TWIN Zebra.** **Note:**

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Sl. No	Clause No.	Existing Provisions	New/ Revised/ Modified Provision
		infrastructure for bay extension works at the existing Substation of KPTCL as cited below: **<u>220k Malur S/s Rs 4,38,60,000/- (inclusive of GST)</u>** 220kV Sarjapura S/s Rs 2,02,22,250/- (inclusive of GST) 220kV Ekarajapura S/s Rs6,51,29,338/-(inclusive of GST) At the time of execution of work, difference in land cost, if any, shall be borne by the TSP. Operation and Maintenance (O&M) of the bays constructed by the TSP within existing KPTCL substations shall be undertaken by KPTCL. The O&M charges shall be recovered by KPTCL from TSP as per the rates prescribed by KERC from time to time. An O&M agreement shall be executed between KPTCL and the TSP in this regard and the agreement will be in line with the Standard Format for Memorandum of Understating between New TSP and Existing TSP" issued by CEA vide its letter No. I/28514/2023 dated 22.06.2023 4.…….	1…. 2…. 3. TSP to pay onetime charges (arrived as per KPTCL norms based on the prevailing guidance value) for use of land and common infrastructure for bay extension works at the existing Substation of KPTCL as cited below: **<u>220k Malur S/s Rs 4,38,60,000/- (inclusive of GST)- deleted from Scope</u>** 220kV Sarjapura S/s Rs 2,02,22,250/- (inclusive of GST) 220kV Ekarajapura S/s Rs6,51,29,338/-(inclusive of GST) At the time of execution of work, difference in land cost, if any, shall be borne by the TSP. Operation and Maintenance (O&M) of the bays constructed by the TSP within existing KPTCL substations shall be undertaken by KPTCL. The O&M charges shall be recovered by KPTCL from TSP as per the rates prescribed by KERC from time to time. An O&M agreement shall be executed between KPTCL and the TSP in this regard and the agreement will be in line with the Standard Format for Memorandum of Understating between New TSP and Existing TSP" issued by CEA vide its letter No. I/28514/2023 dated 22.06.2023 4. ……..

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<tr><th>Sl. No</th><th>Clause No.</th><th>Existing Provisions</th><th>New/ Revised/ Modified Provision</th></tr>
<tr><td>2.</td><td>Clause 2.6, Annexure 8 of RFP and Schedule 2 of TSA</td><td>
<table>
<tr><th>Sl. No.</th><th>Scope of the Transmission Scheme</th><th>Scheduled COD</th><th>Percentage of Quoted Transmission Charges recoverable on Scheduled COD of the Element of the Project</th><th>Element(s) which are pre-required for declaring the commercial operation (COD) of the respective Element</th></tr>
<tr><td>1.</td><td>…..</td><td>……</td><td>……</td><td>……</td></tr>
<tr><td>2.</td><td>…</td><td></td><td></td><td></td></tr>
<tr><td>3.</td><td>Establishing 3X500 MVA, 400/220kV GIS sub-station at Doddathaggalli (Near Hosakote) along with 2x125 MVAr, 400 kV Bus Reactors.

• 400/220 kV ICTs: 3 no.
• 400 kV ICT Bays: 3 Nos
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			• 125 MVAr, 420 kV Bus reactor – 2 No • 400 kV Bus reactor bay: 2 Nos • 220 kV ICT Bays: 3 Nos • **220 kV Line bays: 8 Nos.** • 220 kV BC bay – 1 No • 400 kv Bus PT bay- 2 Nos • 220 kv Bus PT bay- 2 Nos Future Provision: • 400 kV line bays – 4 Nos. • 400/220 kV ICTs - 2 Nos. • 400 kV ICT bays - 2 Nos • 400 kV Bus Reactor: 2 Nos. • 400 kV Bus Reactor bays: 2 Nos. • 220 kV ICT Bays: 2 Nos. • 220 kV Line bays: 4 Nos		• 125 MVAr, 420 kV Bus reactor – 2 No • 400 kV Bus reactor bay: 2 Nos • 220 kV ICT Bays: 3 Nos • **220 kV Line bays: 6 Nos.** • 220 kV BC bay – 1 No • 400 kv Bus PT bay- 2 Nos • 220 kv Bus PT bay- 2 Nos Future Provision: • 400 kV line bays – 4 Nos. • 400/220 kV ICTs - 2 Nos. • 400 kV ICT bays - 2 Nos • 400 kV Bus Reactor: 2 Nos. • 400 kV Bus Reactor bays: 2 Nos. • 220 kV ICT Bays: 2 Nos • 220 kV Line bays: 4 Nos
		4.	…	4.	**……**
		5.	**220 kV DC line with Twin Zebra conductor from proposed 400/220**	5. 6.	**Stands deleted** **220kV DC line with Single Zebra and**

Sl. No	Clause No.	Existing Provisions	New/ Revised/ Modified Provision
			kV Doddathagalli sub-station to existing 220/66kV Malur sub-station with 2 No.s of TB at Malur S/s.
		6.	**220kV DC line with Twin Zebra conductor/UG cable (2500 sqmm)** from proposed 400/220 kV Doddathagalli sub-station to 220kV Ekarajapura sub-station with 2 No.s of AIS TB at Ekarajapura S/s with rearrangement/Shifting of existing Bus PT bay
		7.	**220kV DC line with Twin Zebra conductor/UG cable (2500 sqmm)** from proposed 400/220 kV Doddathagalli sub-station to proposed 220kV Hosakote New sub-station.
			partial 2 runs of 1200 Sq.mm UG cable (based on field conditions) from proposed 400/220 kV Doddathagalli sub-station to 220kV Ekarajapura sub-station with 2 No.s of AIS TB at Ekarajapura S/s with rearrangement/Shifting of existing Bus PT bay **Note: The Tower design shall be suitable for TWIN Zebra.**
		7.	**220kV DC line with partial AAAC Moose and partial 2 runs of 1200 Sq.mm UG cable (based on field conditions)**, from proposed 400/220 kV Doddathagalli sub-station to proposed 220kV Hosakote New sub-station.

Sl. No	Clause No.	Existing Provisions	New/ Revised/ Modified Provision
		8. **220kV DC line with Twin Zebra conductor/ UG Cable (2500 sqmm)** from proposed 400/220kV Doddathagalli to Sarjapura AIS S/s with 2 No.s of outdoor GIS TB at Sarjapura S/s by extending existing AIS bus bar along with AIS isolator	8. **220kV DC line with Single Zebra and partial 2 runs of 1200 Sq.mm UG cable (based on field conditions)** from proposed 400/220kV Doddathagalli to Sarjapura AIS S/s with 2 No.s of outdoor GIS TB at Sarjapura S/s by extending existing AIS bus bar along with AIS isolator **Note: The Tower design shall be suitable for TWIN Zebra.**
3.	RFP & TSA	New clause added	The technical specs of 1200 sqmm UG cable is attached at **Annexure A**
4.	RFP & TSA of "SPECIFIC TECHNICAL REQUIREMENTS FOR COMMUNICATION"	**Clause C.6.0:** **220kV line bays at 400/220kV Doddathaggalli for termination of proposed 220 kV Malur lines along with 2Nos of 220kV TB's at Malur.** **On 220kV line from proposed 400/220kV Doddatahaggalli to 220kV Malur Sub-station, TSP shall supply, install and commission OPGW as per Tower Configurations:** (I) **DC line on Single Towers: One (1) no. OPGW cable containing 48Fibres (48F) to be installed and commissioned by the TSP**	**Stands deleted**

<table>
<tr><th>Sl. No</th><th>Clause No.</th><th>Existing Provisions</th><th>New/ Revised/ Modified Provision</th></tr>
<tr><td></td><td></td><td><u>The TSP shall install OPGW cables from gantry of IPP sub-station up to gantry of 400kV Doddathaggalli with all associated hardware including Vibration Dampers, mid-way and gantry Joint Boxes (called OPGW Hardware hereafter) and finally terminate in Joint Boxes at 400kV Doddathaggalli sub-station and 220kV Malur sub-stations.</u>

<u>Further TSP shall comply to the requirements mentioned as per Appendix-F.1-VOID</u>

<u>Maintenance of OPGW Cable and OPGW Hardware shall be responsibility of TSP</u></td><td></td></tr>
<tr><td>5.</td><td>RFP & TSA of "SPECIFIC TECHNICAL REQUIREMENTS FOR COMMUNICATION</td><td>Clause C.11.0:

……

- PLCC equipment for all the transmission lines covered under the scheme shall be provided by TSP. PLCC to be provided for following lines are under present scope:

<table>
<tr><th>Sl. No.</th><th>Line name</th><th>PLCC configuration</th></tr>
<tr><td>1</td><td>400kV Ryapte-Doddataggalli-1</td><td>Phase-Phase Coupling</td></tr>
<tr><td>2</td><td>400kV Ryapte-Doddataggalli-2</td><td>Phase-Phase Coupling</td></tr>
<tr><td>3</td><td>400kV Doddataggalli-Kolar-1</td><td>Phase-Phase Coupling</td></tr>
<tr><td>4</td><td>400kV Doddataggalli-Kolar-2</td><td>Phase-Phase Coupling</td></tr>
<tr><td><u>5</u></td><td><u>220kV Doddataggalli-Malur-1</u></td><td><u>Phase-Phase Coupling</u></td></tr>
<tr><td><u>6</u></td><td><u>220kV Doddataggalli-Malur-2</u></td><td><u>Phase-Phase Coupling</u></td></tr>
</table></td><td>Clause C.11.0:

……

- PLCC equipment for all the transmission lines covered under the scheme shall be provided by TSP. PLCC to be provided for following lines are under present scope:

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<tr><th>Sl. No</th><th>Line name</th><th>PLCC configuration</th></tr>
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<tr><td>3</td><td>400kV Doddataggalli-Kolar-1</td><td>Phase-Phase Coupling</td></tr>
<tr><td>4</td><td>400kV Doddataggalli-Kolar-2</td><td>Phase-Phase Coupling</td></tr>
<tr><td>5</td><td colspan="2">Stands deleted</td></tr>
<tr><td>6</td><td colspan="2">Stands deleted</td></tr>
</table></td></tr>
</table>

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<tr><td></td><td></td><td>……..</td><td>……..</td></tr>
<tr><td>6.</td><td>RFP & TSA of "SPECIFIC TECHNICAL REQUIREMENTS FOR COMMUNICATION</td><td><u>The BOQ of PLCC for 220kV lines at 400kV Doddataggalli Sub-station:</u>

220kV lines: 1) DC line to 220kV Malur(12km)
2) DC line to 220kV Ekarajapura(20km) (OH+UG)
3) DC line Hoskote_New(25km) (OH+UG)
4) DC line Sarjapura(40km) (OH+UG)

<table>
<tr><th>Sl. No</th><th>Name of materials (Supply & Erection)</th><th>Unit</th><th>At 400kV Doddataggalli</th><th>At 220 kV Malur</th><th>At 220kV Ekarajapura</th><th>At 220kV Hoskote_New</th><th>At 220kV Sarjapura</th><th>Total Quantity</th></tr>
<tr><td>01</td><td>Wave Trap 0.5mH, 2000A, 50kA, 50-500kHz Pedestal Mounting along with mounting structure PI and Hardware. Inter-</td><td>No.</td><td>4</td><td>4</td><td>-</td><td>-</td><td>-</td><td>8</td></tr>
</table></td><td>Stands deleted</td></tr>
</table>

Sl. No	Clause No.	Existing Provisions	New/ Revised/ Modified Provision

	circuit coupling								
02	LMU+LMDU (Coupling device)	Set.	2	2	-	-	-	4	
03	HF Coaxial Cable 75 Ohms	Km	1	0.5	-	-	-	1.5	
04	PLCC Terminal(Carrier Cabinet) Single Channel	No	1	1	-	-	-	2	
05	Protection Coupler -4 Command version	No	1	1	-	-	-	2	
06	DTPC- 8 command with provision for interface with SDH and Direct fiber-in type (220kV DC Source)	No	4	1	1	1	1	8	

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<table>
<tr><td></td><td>Mandatory Spares for PLCC</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>07</td><td>Power Supply module</td><td>Nos.</td><td>01</td><td></td><td>-</td><td>-</td><td></td><td>01</td></tr>
<tr><td>08</td><td>Protection Coupler -4 Command version</td><td>Nos.</td><td>01</td><td></td><td>-</td><td>-</td><td></td><td>01</td></tr>
</table>
</td><td></td></tr>
<tr><td>7.</td><td>RFP & TSA of "SPECIFIC TECHNICAL REQUIREMENTS FOR COMMUNICATION</td><td>
The BOQ of FOTE at 400kV Doddataggalli Sub-station
<table>
<tr><th>Sl No</th><th>Description
MAIN EQUIPMENTS</th><th>Unit</th><th>At 400kv Doddataggalli SS</th></tr>
<tr><td>…</td><td>……</td><td>……</td><td>……</td></tr>
<tr><td></td><td>Optical Interface</td><td></td><td></td></tr>
<tr><td>2</td><td>Trans receiver</td><td></td><td></td></tr>
<tr><td><u>A</u></td><td><u>S16.1 SFP -(30km)</u></td><td><u>No</u></td><td><u>8</u></td></tr>
<tr><td>B</td><td>L16.1 SFP -(30-50 km) -</td><td>No</td><td>2</td></tr>
<tr><td></td><td>……</td><td></td><td>……</td></tr>
<tr><td></td><td>……</td><td></td><td>……</td></tr>
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</td></tr>
</table>

Annexure A

TECHNICAL SPECIFICATIONS FOR SUPPLY, LAYING, TESTING & COMMISSIONING OF 1200 Sq.mm., 220 KV XLPE INSULATED UNDERGROUND CABLE (Annexure A)

1.00.0 SCOPE:

1.01.0 This specification provides for the establishment of an underground cable transmission scheme on total turnkey basis which includes the design, manufacture, inspection and testing before despatch, packing and delivery F.O.R. (destination) of 220 KV, 1200 Sq.mm, Single Core XLPE Insulated lead sheathed cable and accessories under the supply portion and laying, including obtaining permission for road cutting from Bruhath Bengaluru Mahanagara Palike (BBMP), Local Administrative Authorities and other agencies for execution of work, handling and installation of materials required in laying, site testing and commissioning under the erection portion.

1.01.1 SITE:

The site is located in Bengaluru, Karnataka State, India.

Route: Please refer the enclosed drawing for the tentative route plan of the cable.

1.02.0 SCOPE OF WORKS

The scope of work includes:

1.02.1 Surveying of the proposed cable route including digging and closing of trial pits, preparation of requisite drawings and finalizing the cable route in consultation with the owner's representative.
NOTE: In the expected cable route, ground structure may change from one point to another, and in some places like Railway Crossing , Major Road Crossing, the local environment is especially bad which may lead to unexpected accelerated ageing of insulation and would limit the life expectancy of the cable itself. The successful bidder has to execute works by taking all the necessary precautions so as to get 95**0 Amps** of current flow in the cable per circuit (Refer clause No. 4.00 (B)(i)(10)(i) & (ii)).

Even after considering all the derating factors for laying cable in those locations, the minimum continuous current shall be 95**0 Amps** per circuit.

1.02.2 Testing and evaluation of the soil resistivity, soil thermal resistivity, pH value, of the soil along the cable route, and based on the data, recommend the final system design.

a) Perform a through route soil thermal resistivity survey by in-situ testing along the entire cable route.
b) Conduct a detailed analysis of soils / strata encountered along the route for the thermal performance under specified cable loading.
c) Specify a suitable thermal backfill so that the soil thermal resistivity does not exceed 120^0C cm/watt, to encapsulate the cables to prevent thermal run away of cable.
d) Design of optimum cable trench including RCC ducts and optimum backfill dimension.
e) Formulation of thermal backfill, quality control and supervision during backfill.
f) Obtaining Road cutting permission from Bruhath Bangalore MahanagaraPalike (BBMP), Local Administrative Authorities and any other permissions from other utilities.

1.02.3 Design the method of installation of U.G. Cables, cable laying, excavation and back- filling of cable trench, supply and installation of associated materials like sand, bricks, warning tape, protective slabs, pipes, ducts, civil works etc.

1.02.4 Design, manufacture, testing at works / test house, supply, storage, installation, testing and commissioning of 220 kV cables with all associated materials and accessories.

1.02.5 Design, supply erection, testing and commissioning of

a) Surge Voltage limiters
b) Grounding Switches.
c) Link boxes with Links and with/without SVL

1.02.6 Design for the installation, supply of materials and construction of cable ducts, supports for cable crossings of storm water/sewerage drains wherever required. Design, supply of materials and laying of pipes/construction of cable ducts for railway crossing and road crossing wherever required.

1.02.7 Supply, installation, testing and commissioning of

a) Normal straight through joints for Normal bonding/ Cross bonding of cables.
b) Outdoor cable terminations.

1.02.8 Design, supply and erection of structures for mounting / supporting cable with terminations.

1.02.9 Supply of recommended essential spare parts.

1.02.10 Supply of tools and tackles.

1.02.11 Furnishing all relevant drawings, data and instruction manuals.

1.02.12 Supply of all consumable items, like cable end sealing caps for cable during transport and jointing and all others associated sundry materials.

1.03.0 SCOPE OF SERVICES:

1.03.1 The Scope of the services includes supply, installation, laying erection and commissioning of the cable system on total turnkey basis. The scope shall include but not limited to the following.

1.03.2 Complete checking, monitoring, storing of the materials at the site, and co- ordination of work.

1.03.3 Finalize procedure of installation and erection in consultation with owner.

1.03.4 Regular supervision and following up of erection / installation work

1.03.5 Testing and commissioning the system / equipments for successful commercial operation.

1.04.0 The cables and its accessories shall conform in all respects to high standards of engineering, design, workmanship and latest revisions of relevant standards at the time of offer / erection and the owner shall have the power to reject any work or material, which in owner's judgement is not in full accordance therewith.

1.05.0 All the volumes of this bid documents along with amendments thereof be read and interpreted together. However, in case of a contradiction between the "Technical Specification (Vol. II)" (i.e., this volume) and any other volume, the provisions of this volume will prevail.

1.06.0 It is not intent to specify completely all the details of Design and construction of cable and accessories. However, the cable and accessories shall conform in all respects to the high standard of engineering design and workmanship and shall be capable of performing continuous commercial operation up to the suppliers guarantee period in a

manner acceptable to the Owner who will interpret the meanings of drawings and specifications and shall have power to reject any work or material, which in Owner judgment, is not in accordance therewith. The cable offered shall be complete with all the components necessary for its effective and trouble free operation. Such components shall be deemed to be within the scope of the bidder irrespective of whether they are specifically brought out in this specification and/or in the commercial document or not.

NOTE:

1. The scope shall cover supply of all required equipments, accessories, spares and jointing kits and tools and plant, competent supervision and consumables. All other matching materials required (whether specifically mentioned or not) for complete installation, testing and commissioning of the system shall also be covered.

2. After completion of laying and back filling the road shall be restored as per specification of BBMP and applicable local Authorities. Specification of the same is enclosed.

1.07.0 QUANTITIES:

The quantities, length of cable, number of accessories and other materials indicated in the bid proposals are solely for the purpose of bid evaluation. The successful bidder after detailed route survey shall estimate the actual quantities and take up manufacture and procurement action for materials after approval of the Owner.

2.00.0 STANDARDS:

2.01.0 The construction of the cable shall generally conform to IS 7098 (Part-3) and IEC 62067 with exception to the specific requirements of these specifications and tests as per **IEC-62067**. Except to the extent mentioned in the specification, the cables and the accessories shall conform to the latest editions and amendments of the standards listed hereunder wherever applicable.

IEC-60050	Electro Technical vocabulary.
IEC-60060	High Voltage Test Techniques.
IEC-60093	Recommended tests for volume and resistivity of electrical insulating materials.
IEEE-48	Test procedures and requirement for AC cable terminations 2.5 to 765kV
IEC-60122	Recommended method for determining the comparative tracking index of solid insulating

	materials under moist condition.
IEC-60183	Guide to selection of high voltage cables.
IEC-60216	Guide for the determination of thermal endurance properties of electrical insulating materials.
IEC-60228	Conductors of insulated cables.
IEC-60228-A	(First supplement) Guide to the dimensional limits of circular conductors.
IEC-60229	Test on cable over sheaths which have a special protective function and are applied by extrusion.
IEC-60230	Impulse test on cables and their accessories.
IEC-60243	Recommended method of tests for electrical strength of solid insulating materials.
IEC-60250	Recommended method for determination of permittivity, dielectric dissipation factor of electrical insulation materials at power, audio frequencies.
IEC-60270	Partial Discharge measurements
IEC-60287	Calculation of continuous current rating of cables, 100% load factor.
IEC-60540	Test methods for insulation and sheaths of electric cables and cores.
IEC-60811	Common test methods for insulating and sheathing materials of electric cables. (Applicable parts / sections of different editions)
IEC-60840	***Applicable clauses only*** Power cable with extruded insulation for voltages above 30kV (U_m=36kV) up to 150 (U_m=170Kv). Test methods & requirements.
IEC-60853	Calculation of cyclic & emergency current rating of the cable.
IEC-60885-2	Electrical test methods for electric cables, part-2: Partial discharge tests.

IEC-60885-3	Electrical test methods for electric cables part-3 Test methods for partial discharge measurement on lengths of extruded power cables.
IEC-62067	Power cable with extruded insulation and their accessories for rated voltage above 150 kV – Test Methods & requirements.
IEC-60949	Calculation of thermally permissible short circuit currents, taking into account non-adiabatic heating effects.
IS-3043	Code of practice for earthing
IS-1255	Code of practice for laying of power cables.
IS-1885	Electro Technical vocabulary applicable parts.
IS-5216	Guide for safety procedures and practices in electrical works
IS-5831	PVC insulation and sheath of electric cables.
IS 7098 (Part 3)-93	Cross-linked polyethylene insulated, thermoplastic sheathed cables 66kV to 220kV.
IS-8130	Conductors for insulated cables and flexible cords.
IS-10810	Method of test for cables: Applicable parts.
IEC-62271-209	Cable Connection for gas insulated metal enclosed switch gear for rated voltage above 52kV.

Indian Electricity Act - 2003

Indian Electricity Rules, 1956 (Or its Latest Amendments).

NOTE: i) For the purpose of this specification all technical terms used hereinafter shall have the meaning as per relevant IEC/IS specification.

2.02.0 The Standards mentioned above are available from:

Standard	Name & Address

IS	Bureau of Indian Standards, ManakBhavan, 9, BahadurshahZafarMarg, New Delhi – 110 001, INDIA.
IEC	International Electro-Technical Commission, Bureau Central De 1a commission, Electro Technique Internationale, 3, Rue De Verembe,P.O. Box 131 CH - 1211 Geneva 20 – Switzerland.

2.03.0 Cables/Cable accessories satisfying the quality requirements of other National/International standards, which ensure equal or better quality than the standards mentioned above shall also be acceptable. Where the equipment offered by the bidder conforms to other standards, salient points of difference between the standards preferred and the specified standards shall be clearly brought out in the offer. Four (4) copies of the reference standards in English language shall be furnished along with the offer.

3.00.0 SYSTEM DATA:

a) Rated voltage:

The cable defined in this specification have the following rated voltage:

U_o/U (U_m) = 127/220 (245) kV

"U_o" is the r.m.s. rated voltage at power frequency, between the conductor and the earth or the metallic sheath:

U_o = 127 kV

U is the r.m.s. rated voltage at power frequency, between two phase conductors:
U = 220 kV

"U_m" is the maximum r.m.s. voltage at power frequency, between two conductors for which the cable and its accessories are to be designed:

U_m = 245 kV

b) Operating Conditions:

1. Nominal rated voltage (KV rms)	–	220 KV
2. Highest system voltage (kV rms)	–	245 KV
3. Number of phases	–	3
4. System frequency (Hz)	–	50 $\pm$ 3%
5. Impulse withstand voltage 1.2/50 micro seconds wave of positive/negative polarity		

	(kVp)	–	1050
6.	Power frequency withstand voltage (kV rms)	–	460
7.	System earthing	–	Effectively Earthed (Solidly grounded)
8.	Maximum fault level & its duration	–	50KA for 1 Sec
9.	Dynamic withstand capability	–	125 KA
10.	Total Relay & Breaker operating time (Milli seconds)	–	90-120

4.00.0 A. CLIMATIC CONDITIONS:

1.	Ambient air temperature	–	Min 5^0C
		–	Max 50^0C
2.	Average daily ambient air temperature	–	30^0C
3.	Relative humidity	–	10–100%
4.	Ground temperature at a depth of 1500 mm	–	30^0C
5.	Altitude above Mean Sea Level (M)	–	1000
6.	Average Rainfall (mm)/annum	–	1000
7.	Ceraunic level (days/year)	–	40–50
8.	Seismic level (horizontal acceleration)	–	0.3 g

B. OPERATING CONDITIONS:

i. CABLES:

1. Method of installation – Directly buried in ground/RCC cable duct

2.	No. of Circuit	–	Single
3.	Depth of laying (average)	–	1500 mm from the center of cable arrangement
4.	Soil Condition	–	Dry Heterogeneous garden Soil
5.	Thermal Resistivity of soil (assumed) Deg. C-cm/watt	–	120 to 150

Bidder shall furnish the current rating of 1200 Sq.mm cable at Thermal resistivity of soil at 120^0C-Cm/watt and 150^0C-Cm/watt. However the successful bidder has to measure the soil thermal resistivity along the cable route and the cable has to be designed suitably.

6.	Formation	–	Trefoil Touching
7.	Spacing between two circuits (if applicable)	–	800 mm (for 2 Circuits)
8.	Sheath Bonding	–	Cross bonding.

Bidder shall recommend the type of bonding to be adopted with detailed calculation of sheath voltage, sheath current and current rating.

8. No. of cores – Single
9. Conductor size – 1200 Sq.mm
10. Rated continuous current (minimum)
    i. In Air – 1150 Amps.
    ii. In ground – 950 Amps. (after considering all derating factors)
11. Conductor material – Annealed Copper

ii. TERMINATIONS:

1) Installation – Outdoor type/GIS module Plugin Type in conformity with IEC 62271-209.
2) Atmosphere – Polluted.
3) Switchgear - SF6 Circuit breaker (AIS/GIS)
4) Clearance (air) ph-ph – 3650 mm
   at 220kV (phase voltage) ph-earth – 3350 mm

5.00.0 TECHNICAL PARAMETERS OF CABLE:

TYPE OF CABLE:
127/220 kV single core, stranded, annealed, copper conductor, segmental compacted, circular (Miliken), XLPE insulated, lead sheath, copper wire screen, High Density Polyethylene outer sheathed cable (please see details under construction of cable).

The tests shall be as per IEC-62067 with latest amendments.

Voltage grade	–	127/220 (kV rms)
Max. operating conductor temperature	–	90^0C
Max. conductor temperature under short Circuit for 1 sec.	–	250^0C

5.01.0 CONSTRUCTION OF THE CABLE:

Construction : 127/220 kV (Earthed), single core 1200 Sq.mm stranded, annealed, copper conductor, segmental,

compacted, circular (Milliken), conductor screen, cross linked polyethyline (XLPE) insulation, core screen, semi-conducting water swellable layer, lead alloy 'E' sheathed, semi-conducting bedding tapes, helically applied plain round copper wire screen, plain copper tape in open helix, water swellable tape with overall extruded High Density Polythylene sheath coated with graphite.

Conductor : Plain, annealed, high conductivity copper wires stranded, segmental conductor (Milliken).

Conductor screen : Extruded semi-conducting layer.

Insulation : Dry cured cross linked polyethyline.

Nominal thickness 24.00 mm (min)
In any particular point, the thickness may differ from the nominal thickness, however, the measured thickness shall stay within the following limits.
Minimum thickness: $t_{(min)} \geq 0.9\ t_{(nom)}$
And

$$\frac{t_{max} - t_{min}}{t_{max}} \leq 0.10$$

Where t_{max}, t_{min} and t_{nom} are respectively the minimum, maximum & nominal thickness.

The thickness of insulation mentioned is indicative only. However, the thickness of insulation shall be such that the maximum value of electric stress at the insulation screen shall be 4kV/mm, as indicated elsewhere in the specification.

Core/insulation Screen Extruded semi-conducting layer

Longitudinal Water barrier Semi-conducting water swellable tape/s.

Radial Moisture Barrier	Extruded lead alloy 'E'. (Nominal thickness not less than 3.0 mm) The minimum thickness of the metallic sheath shall not fall below the nominal thickness by more than 0.1 mm + 5.0% of the nominal thickness. $t_{min} \geq 0.95 t_{nom} - 0.1$
Bedding	Semi-conducting tape/s.
Armour/Screen	Helically applied non-magnetic plain copper wires.
Contact tape	Annealed plain copper tape in open helix.
Water swellable tape	Non-conducting water swellable tape.
Outer sheath	Extruded High Density Polyethylene type ST 7 (black), antitermite treated. Extruded outer conducting layer coated with graphite. Nominal thickness 3.5 mm

6.00.0 GENERAL TECHNICAL REQUIREMENTS OF THE CABLE:

The size of the conductors of the cable shall be sufficient to carry continuously 950 **Amps** continuously without exceeding a maximum temperature of **90^0C** under site conditions followed by a 20% overload for three hours without exceeding a maximum temperature of 130^0**C for emergency overload** under site conditions. The OWNER estimates that a cross section of 1200 sq.mm Compacted Segmental Circular Milliken conductor would be adequate to carry the stipulated load current.

The conductor size shall be based on loading of the circuit under the conditions indicated in Clause-3.00.00 & 4.00.00 above.

6.01.0 INSULATION CURING:

Dry curing process should be adopted in cross-linking the insulation.

6.02.0 TRIPLE EXTRUSION:

The conductor, screen, insulation and insulation screen shall be extruded in single process. The extrusion process shall be by **VCV method**. The same shall be confirmed in the GTP.

The Cross linked polyethylene insulated (XLPE) cable (Dry cured) shall be manufactured in accordance with the internationally accepted standard and also conform to the requirements of IEC: 62067 for rated voltages from 150KV to 500KV.

6.03.0 DESIGN STRESS AND INSULATION THICKNESS:

The recommended typical design stress values for insulation thickness are:

Design stress a.c. : **10 kV/mm**
Design stress impulse : **40 kV/mm**

The higher of the two values of the insulation thickness will be adopted but not less than the nominal value of 24.00 mm.

6.04.0 DIELECTRIC STRESSES:

The 220 kV cables shall be designed for continuous operation at a maximum line to earth system voltage of 127 kV. The maximum dielectric stress at the conductor screen and insulation screen shall not exceed the following:

For 1200 Sq.mm

a) At conductor screen **8 KV/mm**
b) At the insulation screen **4 kV/mm**

The dielectric stress at 127 kV shall be furnished by the bidder with calculation sheet.

6.05.0 The cable shall be designed to have a minimum useful life of not less than fifty years.The cable manufacturer should submit a graph showing the breakdown voltage with respect to time for the XLPE insulation compound used. In addition the type of XLPE semi-conducting compound used should be indicated i.e., whether supersmooth and purity level.

6.06.0 Each cable length shall be provided with a pulling socket, pulling eye, which shall be fitted to pulling end to withstand the maximum pulling force.

6.07.0 Copper wire screening shall be preferably before the lead sheath to ensure specific water tightness of cable both transversely and longitudinally. However other types of placement of the copper wire screening is also acceptable if it meets the overall technical requirements. The same shall be established by way of Type Test Reports conducted on such cables.

The bidder shall indicate any specific construction features, which will be provided to ensure specific water tightness of cable both transversely and longitudinally.

6.08.0 CURRENT RATING:

The bidder shall furnish the continuous current ratings in ground, in air, in pipes and in

ducts at the maximum conductor temperature of 90^0C with reference to the ambient site conditions on the guidelines of IEC 60287. Any additional data, other than furnished under climatic conditions and operating conditions may be suitably assumed. However, the same shall be furnished in GTP for reference. The ratings shall be for Trefoil touching formation when the sheaths are single point bonded and both ends bonded or cross bonded (without exceeding the stipulated sheath voltage of **65 volts** or undue high circulating currents).
The current ratings shall be for single circuit/double circuit in operation.

The bidder shall also furnish technical information on:

i) Derating factors for various types of installation conditions in trefoil and flat (viz., depth of laying, varying ground temperatures, cables in ducts / pipes, cable spacings, circuit spacings, varying soil thermal resistivities etc.) shall be furnished by the bidder for the following conditions:

(a) Proximity to other 220 kV cables.
- Variation of number of cables (max. 12 in number).
- Variation in spacing.
- Variation in loading of the cables (80% to 100%).

(b) Variation in depth of water table.
(c) Depth of laying cables in trenches and cable ducts.
(d) Depth of **Stabilised Thermal Backfill (STB)** below and above laid cables.
(e) Width of trench on either side of the cables in which **STB** will be put.
(f) Variation in STB effective thermal resistivity.
(g) Variation in soil thermal resistivity.
(h) Laying of cables in long lengths of HDPE pipe, 19 mm thick – Variation due to size and thickness of pipe and open space available in pipe – BIDDER shall suggest methods to improve the ratings.

ii) Short Time Current Loading:

The current loading permissible for a defined period of short time operation, over the cyclic load as under.

Cyclic loading over a 24 hour period.

2100	to	0600 Hours	(9 Hours)	**50%**
0600	to	0900 Hours	(3 Hours)	120%
0900	to	1800 Hours	(9 Hours)	**100%**
1800	to	2100 Hours	(3 Hours)	120%

Furnish short time loading for the following conditions.
i) Only one circuit is live.
ii) When both circuits are live.

When cables are laid in trefoil touching formation.

i) Single point bonded.
ii) Both end bonded.
iii) Cross bonded.

The bidders should furnish GA drawing/other details with supporting calculations on charging current, capacitance, inductance, losses, sheath voltages, sheath currents, surge impedance, sequence impedance and screen factors, detailed drawings etc., along with the bidding documents.

6.08.1 MECHANICAL CHARACTERISTICS OF CABLE:

The cable shall withstand the electromechanical forces due to peak short circuit currents of **125KA** and shall withstand the stresses of thermal expansion in the insulation due to faults. The cable shall withstand the mechanical stresses during installation.

6.09.0 TEMPERATURE RISE:

The maximum conductor temperature shall not exceed 90^0C during continuous operation at full rated current at 220 kV followed by 20% overload for three hours, maximum temperature not exceeding 130^0C. The temperature after a short circuit for one second shall not exceed 250^0C, with initial conductor temperature of 90^0C.

6.10.0 EMERGENCY LOADING:

The BIDDER shall indicate the maximum percentage overload current that the cable can carry and its duration when operating initially at a conductor temperature of 90^0C and the permissible final conductor temperature after overload. The total period during the lifetime of the cable when it shall be subjected to emergency loading without affecting the expected life of the cable shall also be indicated.

6.11.0 CYCLIC RATING:

The BIDDER shall also indicate the percentage overload current that the cable can carry and its duration, without the conductor temperature exceeding 90^0C due to the time lag in conductor temperature change on account of the change in thermal characteristics of the mass of the soil surrounding the cable.

6.12.0 CABLE MATERIAL:

a)Conductor:

Plain annealed high conductivity copper wires, stranded, segmental conductor while conforming to IEC-60228. The Copper used for the conductor shall be of highest

purity. The minimum number of wires and conductors and DC resistance of conductor shall be as per IEC-60228.

b) Conductor Screen:

The conductor screen shall be provided over the conductor by extrusion of semi-conducting compound or by a combination of semi-conducting tape/s and extruded semi-conducting compound. The minimum thickness, excluding tape/s shall be 1.5 mm.

c) Insulation:

Cross-linked polyethylene insulation by dry curing process shall be provided over the conductor screen. The nominal thickness of 24.00 mm and subject to tolerance as per IEC-62067, Clause 10.6.2.

The insulation shall be of high quality, and shall be as far as possible free from contaminants, moisture and voids. The size of voids and contaminants shall be within limits of recognized National/IEC Standards.

The insulation shall be suitable for operation in wet or dry locations at conductor temperature not exceeding 90^0C for normal operation, 130^0C for emergency over load of short duration, and 250^0C for short circuit conditions.

d) Insulation Screen:

Shall be by extruded semi conducting compound and of minimum thickness 1.0 mm. The semi conducting screens shall be suitable for the operating temperatures of the cable and compatible with the insulation.

e) Moisture Barrier (Longitudinal):

This shall be semi-conducting synthetic non-woven tape with suitable swellable absorbent for longitudinal water sealing covering the whole surface area of the non-metallic part of insulation screening. This barrier shall restrict longitudinal water penetration under the metallic sheath. The nominal thickness of water blocking tape shall not be less than 0.3 mm.

f) Metal Sheath/Moisture Barrier (Radial):

Shall be extruded lead alloy 'E' sheath.

The nominal thickness of lead alloy sheath shall be 3.0 mm and shall meet the Electrical and Mechanical properties as per standards. The minimum thickness shall be as per IEC-62067 (Clause 10.7.1).

g) Bedding Tapes:

Suitable semiconducting bedding tapes shall be used under metallic screen of approximate thickness 0.3 mm.

h) Metallic Screen (Armour):

The metallic screen shall be of non-magnetic plain copper round wires, helically applied over the semiconducting bedding tape/s.

A binder tape of suitable material/annealed plain copper shall be applied in the form of an open helix, over the metallic screen.

Note: Requirement of Metallic Sheath/Screen:

The metallic screen can be before or after the lead sheath. However, it shall be as per the manufacturer's type tested design.

The cross section of the metallic sheath that is lead sheath in combination with plain copper round wire screen shall be designed to meet the following requirements:

i) Sustaining the system short circuit rating of **50 KA** for 1 Sec.

   The temperature of metallic sheath at the time of short circuit (cable operating at maximum conductor temperature) shall be indicated in the short circuit calculations of the design of metallic screen/lead sheath.

ii) Ensuring mechanical protection of the cable.

iii) Ensuring radial water tightness of the cable.

Note: Test report ensuring the above compliance has to be submitted by the bidder along with the bid.

i) Outer Sheath:

The outer sheath shall be extruded Black colour High Density Polyethylene, type ST 7 conforming to requirement of IEC. The High Density Polyethylene compound used shall be brand new from a reputed manufacturer and in no case shall recycled material be used.

The outer sheath shall be designed for protection against termite and rodent attacks by adding suitable additives to HDPE compound and such additives shall be harmless to operating personnel. The minimum thickness of outer sheath shall be 3.5 mm.

j) Coating:

A hard baked on layer of graphite shall be applied over the sheath as outer electrode

for testing the sheath.

6.13.0 IDENTIFICATION:

The following information shall be embossed on the outer sheath of the cable continuously repeated throughout the length of the cable.

i) Brand Name of Manufacturer:
ii) Year of Manufacture:
iii) Voltage rating / conductor cross section: 220,000V/1200 Sq.mm
iv) K.P.T.C.L.
v) XLPE

7.00.0 CABLE ACCESSORIES:

7.01.0 GENERAL:

Following are the accessories required.

(a) Straight through normal as well as cross bonded joints suitable for directly buried in ground conditions/RCC Cable Ducts.

(b) Outdoor type cable end terminations/GIS module plugin type.

The above accessories shall be suitable for the 127/220 kV, single core 1200 Sq.mm copper conductor lead sheathed cable. The detailed cable construction is given in these specifications under clause 5.01.00

7.02.0 TECHNICAL REQUIREMENTS:

The accessories should be compatible with the size of the conductor, the insulation and the voltage class of the cable. The components of the accessory shall not be affected by contact with the component materials of cable, and shall not corrode any metal, which they come in contact. The accessory, in the assembled condition, shall be capable of operating under the normal and fault temperature conditions of the cable.

The cable accessories should be procured only from reputed manufactures & type test reports shall be submitted along with the bid.

7.02.1 CABLE JOINT:

The Cable joints shall be suitable for 220 kV Single Core, 1200 Sq.mm copper conductor, lead sheathed XLPE cable and conforming to relevant IEC specification.

The joints shall be suitable for size of the conductor, the insulation, voltage and current ratings of the cable. The required service conditions are horizontal installation, directly buried in earth, laid in RCC cable duct and intermittently or continuously submerged in water.

The BIDDER shall quote for the required quantity of prefabricated type Cable joints which shall comprise of a Factory Tested One Piece Pre Moulded Silicone Rubber joint body moulded from a special Silicone Rubber formulation to provide perfect compression force for optimized electrical performance and afford very simple, reliable, consistent installation. Conductor Jointing should be either with mechanical connectors or a proven crimping technique. Outer mechanical protection with integrated moisture protection must be provided and the manufacturer must provide a detailed description of this. Solderless Jointing technique for the lead sheath and copper wire screen must be provided. Further, the straight through joint shall be able to

(i) Provide a seal against the entrance of moisture or external environment.

(ii) The assembled joint should be resistant to corrosive agents present in the soil, should be mechanically strong to withstand pressure, bending, pulling fatigue. The joint should withstand temperature variations under normal load and fault conditions.

7.02.2 OUTDOOR CABLE END TERMINATION:

The cable end terminations shall be outdoor type suitable for 220 kV SC, 1200 Sq.mm copper conductor, lead sheathed XLPE cable and shall be designed to perform under severe environmental conditions and also conform to the relevant IEC Specifications.

The outdoor termination should have a pre moulded silicone rubber stress cone to provide the electrical stress control function at the end of screen/shield and should be easily applied without tools It should avoid partial discharges and surface corona under severe service conditions. The cone should be placed on the cable terminated within a pressure tight composite housing made of glass fibre reinforced resin tube with silicone rubber sheds moulded to the tube. The interface between the stress cone, cable insulation and inner housing must be filled with a silicone oil poured from the top. No heating of the silicone oil prior to pouring should be required. It should seal any ingress of atmospheric elements. A flexible double sealing system which is installer friendly must be provided to provide protection against environmental influences. An oil resistant barrier must be provided over the conductor to prevent any oil migration the total creepage distance shall not be less than 6125 mm.

The outdoor termination shall be suitable for the insulation, voltage, conductor size and current rating of the cable.

The sealing ends shall conform to the latest International Standards and shall be of thoroughly proven design. The outdoor type sealing ends shall be suitable for installation in polluted atmosphere referred to in clause 4.00.00 and shall be completely weather proof. Each outdoor type-sealing end shall be supplied complete with four mounting plate insulators to insulate the sealing end from the supporting structures and to control the sheath current. All metallic fittings must be made of corrosion resistant aluminium alloy. Terminal connectors and bimetallic clamps shall also be supplied. Each sealing end shall be provided with consumable materials such as wipes and solvent for cleaning. A Cable Gland for the shield connection and lead sheath connection must be provided and this should be sealed from the external environment with a heat shrinkable sleeve. The power cable leading to sealing end shall be provided with proper sunshield cover.

The material for the housing of the termination should be resistant to tracking, ultra violet radiation (U.V. Exposure) weathering and should have stable hydrophobic properties.

The bidder shall provide necessary arrangement to limit flow of current in the structure supporting the sealing end.

The sealing ends shall withstand the power frequency, impulse and cable testing voltage after installation as specified.

The cable and accessories shall withstand all thermal and mechanical stresses under steady state and transient operating conditions.

7.03.0 TECHNICAL ASSISTANCE/TRAINING:

The successful bidder shall arrange with the suppliers of cable joints and / or terminations, the technical assistance in jointing / terminating the cable during installation at the site. The successful bidder shall arrange to train the owner's personnel in jointing and terminating techniques during the installation.

7.04.0 LINK BOXES:

7.04.1 Link Boxes along the run of the 220 kV Cable:

a) Link boxes for grounding of the sheaths of single core cables along the run of the cables shall be made of cast iron/aluminium alloy/stainless steel, suitable for direct burial in the same ground conditions as the cable with anti-rust protection suitable for completely underground installation and for operation when immersed in water. The link box shall conform to IP-66 degree of protection for which the test reports shall be furnished.
The bidder shall furnish a copy of type tests certificates for the link box offered as

per the specification from any of the laboratories indicated in Cl.No. 10.02.10 or any other NABL Accredited Laboratories.
The design of the box must include a top Lid, which can be lifted vertically. BIDDER to submit the detailed drawing of these boxes along with the Bid. These Link Boxes shall be easily accessible from road surface in case of installation in joint pit. The box shall ensure complete water tightness.

b) These Link Boxes shall be suitable for terminating the cable sheaths on either side of joint bays based on cable route for cross bonding at the box as well as for earthing at recommended locations.

c) All accessories such as copper terminals, cable lugs, connecting links, disconnecting links, washers, gaskets, mounting arrangements, etc., shall be provided to make the system complete.

d) The cross bonding link box shall be designed to be completely water proof and capable of immersion in water.

e) The cable leads from sheath to link box, capable of withstanding 10 kV DC and cable leads from link box to earth shall also be in BIDDER's scope of supply. The BIDDER shall quote for the type of cable leads for the cross bonding system as per the following design:

Concentric bonding leads of suitable size corresponding to three-(3) nos. co-axial cable entries to the cross bonding box.
Non–linear resistor type surge divertors of metal oxide type, wherever required, shall be provided in the link box by the BIDDER.

f) The BIDDER may quote for link boxes of suitable design in which the surge voltage limiters (SVLs) do not need to be disconnected when a routine 10 kV DC test on the cable outersheath is performed.

7.04.2 Link boxes at the circuit end:

The lead sheath shall be grounded through suitable disconnecting links at the base of sealing ends. The BIDDER shall clearly indicate whether the links are to be grounded directly or through SVLs (non-linear resistors). The links shall be housed in a weather proof, outdoor, galvanised sheet steel box or cast iron or aluminium alloy box with mounting brackets and provided with 'O' Ring gasketted door. The cable leads from the sheath to the link box, capable of withstanding 10 kV DC & cable leads from link box to earth shall form a part of the scope of supply of the BIDDER. The Bidder shall quote for the same.

7.04.3 Cross Bonding of cable sheath:

The BIDDER shall give his recommendations regarding cross bonding of cable sheaths for the flat formation of single core cables. The BIDDER shall clearly indicate the numberof joints to be directly earthed and those to be earthed through zinc oxide (Z_nO), non- linear resistors (sheath voltage limiters). The offer may indicate a suitable design whereby Z_nO resistors need not be disconnected while conducting routine DC test on the over sheath.

The sheath standing voltage to earth for rated cable current shall not be in excess of 65 V RMS.

The sheath voltage, during an external three phase, symmetrical through fault as specified, should not be in excess of 3.3 KV for 3 sec.

The BIDDER shall indicate the arrangement considered by him in his proposal to meet the above requirements with suitable non-linear resistors, if required, to limit the sheath voltage.

Detailed calculations for sheath voltages as per recommended bonding methods shall be furnished along with the bid.

The BIDDER shall indicate permissible variation in the lengths of the 3 minor sections of a major section, which will not affect the efficacy of the cross bonding.

The BIDDER shall confirm that the cable can be continued in service in the event of a sheath fault and shall indicate the de-rating of the cable in case of an earth on the sheath at the link box earthed through SVLs.

Transposition of cables:

The BIDDER shall indicate and provide arrangement for transposition of cables if necessary along with cross bonding. The Details of the same shall be furnished alongwith the bids.

7.04.4 VOID

7.04.5 VOID

7.04.6 Partial Discharge (PD) Measurement System: VOID

7.05.0 DTS (Distributed Temperature Sensor) with RTTR: void

7.06.0 SHEATH BONDING CABLE AND EARTHING CABLE:

The sheath bonding cable shall be co-axial cable 6.6 kV and above grade with400/400 Sq.mm (conductor/concentric conductor) stranded Copper conductor PVC insulated wire armoured and PVC sheathed. The earthing cable shall be 3.3kV & above grade with 400Sq.mm stranded copper conductor PVC insulated & PVCsheathed. However the rating and the size of sheath bonding cable and earthing cable mentioned are indicative and minimum values. The bidder may quote the actual rating and size of cable offered, to meet the requirement.

7.07.0 PIPE EARTH STATIONS:

The earthing shall be as per provisions of IS:3043, Code of practice for earthing and as per IE rules:1956 Or its Latest Amendments.

8.00.0 ELECTROLYSIS AND CORROSION:

The cable serving shall be designed such that the cable sheath and armouring are protected from electrolysis caused by stray currents, from galvanic action and from corrosion and microbiological attack. The design of accessories shall be such that the outer metallic coverings of cable joints, sealing ends and control points can be insulated from earth along the entire route so that cathodic protection, if needed can be applied and also periodic testing of the insulating resistance of the serving can be done. A set of links shall be provided at each end of cables to connect the cable sheath and armour to the respective station grounds. The sealing ends shall be suitably insulated from their supporting structures, to permit insulation test on the cable over sheath.

9.00.0 GROUNDING SYSTEM:

The BIDDER shall indicate his recommendations regarding the type of grounding systems for the lead sheath/armour. The scope of supply shall include ground rod or ground conductor as recommended. The grounding material shall be copper.

10.00.1 TESTS ON CABLES AND ACCESSORIES:

10.01.0 APPLICABLE STANDARDS:

The testing procedures and requirements shall conform to the latest edition of the following national and international standards, but not limited to:

a) IEC publication 60540
b) IEC publication 60228
c) IEC publication 60229
d) British Standard Specification 6622

e) IEC publication 60840 ***(only applicable Sections of the Standard)***
f) IEC publication 60230
g) IEC publication 60287
h) IEC publication 60811
i) IEC publication 60885
j) IEC publication 62067

The IEC Standards shall prevail whenever the same tests are specified in other standards.

10.02.0 TESTS:

10.02.1 The Owner is keen to procure cables of highest integrity. To provide adequate confidence to the owner for the long term reliability of the cables, the manufacturer has to carry out the prequalification tests on cables and their accessories in accordance with IEC-62067:2011.
The prequalification tests should have been conducted on complete cable system as per clause 13 of IEC-62067.
Prequalification test report shall be furnished along with the bid documents, which is mandatory.

The prequalification tests are to determine long term reliability of a cables system. Hence it is necessary to carry out a long term accelerated ageing test. This test isto be performed as per clause no. 13.2 of IEC-62067 on the complete systemcomprising cables (specified in Tender) joints and termination in order to demonstrate the performance of the system.

The bidder shall enclose a detailed report of prequalification test as per clause No.13.2 of IEC-62067 along with the bid.

After qualification of these tests, regular routine, acceptance and type tests are to be conducted in any one of the approved labs as indicated in the clause 10.02.10 onthe samples and cables manufactured for the Owner.

10.02.2 The bidder shall include the field test report of similar size and voltage class cables installed in actual service. The report shall include voltage class, size, actual voltage, actual load current data, sheath voltage, sheath/conductor temperature data and all events after installation during service of such cable till date etc.

10.02.3 Type tests shall mean those tests, which are to be carried out to prove the process of manufacture and general conformity of the material to this specification. These tests shall be carried out on samples prior to commencement of commercial

production against the order. The Bidder shall indicate his schedule for carrying out these tests in the activity schedule.

10.02.4 Acceptance tests shall mean those tests, which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of the lot.

10.02.5 Routine Tests shall mean those tests, which are to be carried out on each strand/spool/length of the cable to check requirements, which are likely to vary during production and to demonstrate the integrity of the cables to be delivered to the customers for use.

10.02.6 Tests during manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the Bidder to ensure the desired quality of the end product to be supplied by him.

10.02.7 The Standards and norms to which these tests will be carried out are mentioned elsewhere in these specifications. Where a particular test is a specific requirement of this specification, the norms and procedures of the test shall be mutually agreed to between the Bidder and the Owner in the Quality Assurance Programme.

10.02.8 For all type and acceptance tests, the acceptance values shall be the values guaranteed by the Supplier in the proforma for "Guaranteed Technical Particulars", furnished in this Specification or acceptance value specified in this specification, whichever is more stringent for that particular test.

10.02.9 All tests – routine, acceptance and type tests shall be as per IEC-62067 and its Latest Amendments.

10.02.10 The adequacy of Partial Discharge detector used for Partial Discharge tests required for drum lengths of cables under routine tests must be demonstrated by performing tests as per IEC-60885 (3) – 1988.

The bidder shall furnish a copy of type tests certificates for the cable and accessories offered as per the specification from any of the following laboratory on similar cable and accessories as offered for this tender in compliance with IEC:62067, CL.No.12.2: Range of Type approval. The test should have been conducted within the last 10 years as on the last date of submission of bid. No charge is payable by the owner for the type tests.

a) For cables & accessories manufactured in India:

i. Type tests on indigenous equipment for which testing facility is available in India, should have been conducted in any independent laboratories

approved by Government or accredited by National accreditation body of the country like Central Power Research Institute (CPRI), Electrical Research and Development Association (ERDA), etc.

ii. Type tests on indigenous equipment, for which testing facility is not available in India, should have been conducted in a laboratory of foreign country accredited by National accreditation body of that country.

iii. The type tests conducted in-house by manufacturers shall also be acceptable where the specific test facilities are not available in independent NABL accredited laboratories provided the lab (manufacturer's) is accredited by National accreditation body of the country and the tests have been witnessed by a representative of NABL accredited Independentlaboratory/Power utility.

b) For cables & accessories manufactured Abroad:

i. Type tests on imported equipment should have been conducted in an Indian laboratory or foreign laboratory accredited by National accreditation body of respective country.

ii. Type tests conducted in-house by manufacturers shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests have been witnessed by a representative of accreditation body/Power utility.

Following are the type test reports which are to be enclosed/uploaded in the bid.

1) Prequalification test – (Cl. 10.02.1 of specification)
2) Electrical Type tests as per – (Cl. 10.03 (1)(a) to (j) of specification).
3) Non-Electrical Type tests as per – (Cl. No. 10.03 (2) (a) to(o) of specification).
4) Special test as per- (Cl. 10.06 (a) (i) & (ii) of specification)
5) Type test for Link box- (Cl. No. 7.04.1 of specification)

10.02.12 Tests to be conducted during the supplies/after completion of supplies for acceptance of cable and accessories will be at the discretion of the Owner.

1) CABLE:

The owner will select at random a test sample of cable from the lot and subject it to **<u>either a particular type test or</u>** full range of type tests as per IEC-62067: 2011.

The bidder shall prepare the sample for tests and organize testing.

The type test/s will be conducted at Owner's cost.

However, the bidder shall make arrangements for transportation of test samples from manufacturing unit to the Test Laboratory indicated by owner at

his cost.

The applicable type test charges for only to such tests to be conducted as per owner's instructions will be payable by the Owner.(Refer Note (e) given below).

If the cable fails in any of the type tests, the entire lot of cable will be rejected.

2) JOINTS & TERMINATION:

Two Terminations and one joint will be selected at random out of the supplies and subjected to **either a particular Type test or** full range of type and other tests at any reputed testing house/laboratory to IEC 62067: 2011 and tests shall be carried out accordingly.

The bidder shall prepare the sample for tests and organise testing. The type test/s will be conducted at Owner's cost.

However, the bidder shall make arrangements for transportation of test samples from manufacturing unit to the Test Laboratory indicated by owner at his cost.

The applicable type test charges for only to such tests to be conducted as per owner's instructions will be payable by the Owner.(Refer Note (e) given below).

If the sample under test i.e., cable / joint / termination fails, the entire lot of cable / joint / termination will be rejected.

3) The tests mentioned in (1) & (2) above are independent of the type test reports already furnished by the supplier.

NOTE: (a) The waival of any type tests shall be at the sole discretion of the owner.

(b) The successful bidder/vendor shall provide the associated cable and testing material for tests at his own cost.

(c) The cost towards **each** type test shall be clearly indicated **seperately** in the bid and the same will be included for bid evaluation.

(d) The owner may modify tests by including additional tests or delete certain tests at his discretion.

(e) The test charges would be paid by the owner only for such tests that are, conducted successfully in a third party lab other than manufacturer lab. If the tests are conducted at Manufacturer lab no charges would be paid for such tests. However, the bidder has to quote for such tests. And in case of failure of the test material, the entire lot of cable/joint/termination will be rejected.

10.03.0 TYPE TESTS ON CABLE SYSTEM (CABLES & CABLE ACCESSORIES):

The following type tests comprising the electrical tests on the completed cable and the appropriate tests on the cable components shall be conducted in any of the laboratory to be approved by a in the presence of the owner's representative.

The owner may at his discretion, waive the type tests, modify the tests, request for additional tests.

1) The type tests and sequence of electrical test (as per following clauses of IEC 62067) on complete cable system shall be:

   a) Bending Test on the cable (Cl.12.4.3) followed by installation of accessories and a partial discharge test at ambient temperature (Cl. 12.4.4)
   b) Tan Delta measurement (Cl:12.4.5)
   c) Heating cycle voltage test (Cl:12.4.7)
   d) Partial discharge test (Cl:12.4.4)
      - at ambient temperature, and
      - at high temperature.
      The tests shall be carried out after the final cycle of item (c) above or alternatively, after the lightning impulse voltage test in item (f) below.
   e) Switching impulse voltage test (required for Um ≥300kV Cl.12.4.7.1)
   f) Lightning impulse voltage test followed by a power frequency voltage test (Cl.12.4.7.2)
   g) Partial discharge tests, if not previously carried out in item (d) above
   h) Examination of the cable system with cable and accessories on completion of the above tests (Cl. 12.4.8)
   i) The resistivity of the cable semi-conducting screens (Cl. 12.4.9) shall be measured on a separate sample.

2) The Non Electrical type tests (as per the following clauses of IEC 62067) on cable components & on completed cable shall be:

   a) Check the cable construction (Cl. 12.5.1)
   b) Tests for determining the mechanical properties of insulation before and after ageing (Cl. 12.5.2)
   c) Tests for determining the mechanical properties of oversheaths before and after ageing (Cl. 12.5.3)
   d) Ageing tests on pieces of complete cable to check compatibility of materials (Cl. 12.5.4)
   e) Pressure test at high temperature on oversheaths (Cl. 12.5.6)
   f) Hot set test for EPR and XLPE insulations (Cl. 12.5.10)

g) Measurement of density of HDPE insulation (Cl. 12.5.11)

h) Measurement of carbon black content of black PE oversheaths (ST_3 and ST_7) (Cl. 12.5.12)

i) Test under fire conditions (Cl. 12.5.13)

j) Water penetration test (Cl. 12.5.14)

k) Tests on components of cables with a longitudinally applied metal type or foil, bonded to the oversheath (Cl. 12.5.15)

Note: All the applicable tests as per IEC-62067 shall be conducted for the cable requirement of this specification.

10.04.0 ROUTINE TESTS ON CABLE AND ON THE MAIN INSULATION OF PREFABRICATED ACCESSORIES:

The following tests (as per following clauses of IEC-62067) shall be carried out on each manufactured length of cable:

a) Partial discharge test (Clause 9.2).
b) Voltage test (Clause 9.3).
c) Electrical test on over sheath of the cable (Clause 9.4).
d) Conductor resistance test (Clause 10.5).

10.05.0 ACCEPTANCE TEST / SAMPLE TESTS ON CABLES:

The following tests (as per following clauses of IEC-62067) shall be carried out on samples.

a) Conductor examination (Clause 10.4).
b) Measurement of electrical resistance of conductor and of metal screen/sheath (Clause 10.5).
c) Measurement of thickness of insulation and oversheath (Clause 10.6).
d) Measurement of thickness of metallic sheath (Clause 10.7).
e) Measurement of diameters, if required (Clause 10.8)
f) Hot set test for XLPE and EPR insulation (Clause 10.9).
g) Measurement of capacitance (Clause 10.10).
h) Lightning impulse voltage test (Clause 10.12).
i) Water penetration test, if applicable (Clause 10.13)

Note: All the applicable acceptance tests/sample tests as per IEC-62067 shall be conducted for the cable requirement of this specification.

Frequency of Acceptance Tests:

The acceptance tests shall be conducted on one drum length from each manufacturing series of the same type and size of cables, but shall be limited to not more than 10% of the number of drum lengths, rounded to upper unity. However,

water penetration test & lightning impulse test shall be on one length for the order upto 20Kms and two lengths for more than 20kMs order.

10.06.0 (a) SPECIAL TESTS ON CABLES:

The following are the additional special tests:

i) Short circuit test on metallic wire screen and lead sheath, in combination at 50kA for 1 Sec with conductor temperature during the test at 90^0C.

ii) Test for ovality of the core.

iii) (a) The waival of type tests shall be at the sole discretion of the owner.

(b) The successful bidder/vendor shall provide the associated cable and testing material for tests at his own cost.

(c) The cost towards type tests shall be clearly indicated in the bid and will be included for bid evaluation.

(d) The owner may modify tests by including additional tests or delete certain tests at his discretion.

e) The test charges would be paid by the owner only for such tests that are, conducted successfully in a third party lab other than manufacturer lab. If the tests are conducted at Manufacturer lab no charges would be paid for such tests. However, the bidder has to quote for such tests. And in case of failure of the test material, the entire lot of cable/joint/termination will be rejected

10.07.0 SPECIAL TEST ON ACCESSORIES:

10.07.1 JOINTS

Cyclic ageing test under water.

The Test shall be conducted as per IEC 62067 Annexure – G

10.07.2 OUTDOOR TERMINATION:

The outdoor termination should meet the following additional test requirements

(i) Power frequency voltage wet withstand test as per latest version of IEC-62067 standard.

(ii) Salt fog test as per IEC.

(iii) Material test (if applicable)
   a) Tracking and erosion resistance
   b) Thermal ageing
   c) Weather resistance

10.08.0 ADDITIONAL TESTS:

Following tests shall be carried out as per IEC-62067: 2011, Cl. No. 16.0 on the complete installation after completion of cable laying, jointing and providing all necessary accessories.

a) Insulation resistance test.
b) DC voltage test of over sheath & AC voltage test of the insulation in accordance with IEC-62067: 2011 (Cl. No. 16.2 & 16.3).
c) Site tests on non-metallic sheaths in accordance with latest version of IEC-60229.

The supplier shall also indicate any additional special test at site recommended by them to ensure satisfactory operation.

10.08.1 The Bidder shall furnish all the testing details in a compact disc (CD).

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11.00.0 IDENTIFICATION:

The Cable should be identified by embossed letters in English as per Clause 6.13 of technical specification.

The accessories shall be marked with voltage class, size of cable conductor, manufacturers name or trademark, date of manufacture and relevant technical information.

12.00.0 QUALITY ASSURANCE PLAN:

a) The bidder shall invariably furnish the following information along with his offer failing which the offer shall be liable for rejection. Information shall be separately given for individual type of equipment offered.

   i. Structure of the organization.

ii. The duties and responsibilities assigned to staff for ensuring quality of work.

iii. The system of purchasing, taking delivery and verification of materials.

iv. The system for ensuring quality of workmanship.

v. The quality assurance arrangements shall conform to the relevant requirement of ISO-9001 or ISO-9002 as applicable.

vi. Statement giving list of important raw materials, names of sub-suppliers for the raw materials, list of standards according to which the raw materials are tested, list of tests normally carried out on raw materials in the presence of suppliers representative, copies of test certificates.

vii. List of manufacturing facilities available.

viii. Manufacturing process shall be fully automatic with dust proof/Air conditioned working atmosphere.

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

x. List of testing equipment available with the bidder for final testing of equipment specified and test plant limitation, if any vis-à-vis the type.Special acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the "Schedule of Deviations" from the specified test requirements.

xi. Level of automation achieved & test of areas where manual processing exists.

b) The Successful bidder shall within 30 days of placement of order, submit the following information to the Owner.

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

ii. Type test certificates of the bought out accessories if required by the Owner.

iii. Quality Assurance Plan (QAP) with holds points for owner inspection. QAP and owners hold points shall be discussed between the owner and successful bidder before the QAP is finalized.

iv. The successful bidder shall submit the routine test certificates of bought out accessories and central excise passes for raw material at the time of routine testing if required by the owner and ensure that the quality assurance

requirements of specifications are followed by the sub-contractor.

c) The Quality Assurance Programme shall give a description of the Quality System and Quality Plans with the following details:

i. Quality System

- The Structure of the organization.
- The duties and responsibilities assigned to staff for ensuring quality of work.
- The system of purchasing, taking delivery and verification of materials.
- The system of ensuring quality workmanship.
- The system of control of documentation.
- The system of retention of records.
- The arrangement of successful bidder internal auditing.
- A list of administrative and work procedures required to achieve successful bidder quality requirements. These procedures shall be made readily available to the Owner for inspection on request.

ii. Quality Plans:

- An outline of the proposed work and programme sequence.
- The structure of contractor's organizations for the contract.
- The duties and responsibilities ensuring quality of work.
- Hold and notification points.
- Submission of engineering documents required by this specification.
- The Inspection of the materials and components on request.
- Reference to successful bidder work procedures appropriate to each activity.
- Inspection during fabrication/construction.
- Final inspection and test.

The Owner reserves the right to seek documentary proof of the source of material

(insulation, outer sheath, and other cable components) and to cross check with the supplier.

13.00.0 INSPECTION:

Inspection may be carried out by the owner at any stage of manufacture. The successful bidder shall grant free access to the owner's representative at a reasonable time when the work is in progress. Inspection and acceptance of any equipment under this specification by the owner shall not relieve the bidder 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 owner informed in advance about the manufacturing programme so that arrangement can be made for inspection.

13.02.0 The owner reserves the right to insist for witnessing the acceptance/ routine testing of the bought out items.

13.03.0 No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested in presence of the owner's representative and cleared for despatch.

14.00.0 PACKING AND MARKING:

14.01.0 DELIVERY LENGTH OF CABLE:

It is important to note that the correct delivery length on each drum and the total number of drums to be delivered shall be ascertained by the successful bidder before manufacture, by cable route survey and approval of the owner.
The inner diameter of the drum shall not be less than 20 D and the minimum delivery length of the cable on each drum shall be approximately 500 Mtrs (Five Hundred) subject to approval of the owner.

14.02.0 The cable shall be wound on non-returnable strong steel drums. The dimensional drawings of steel drums shall be furnished with the bid. The drum shall be provided

with circumferential lagging of strong wooden planks. The ends of the cable shall be sealed with good quality heat shrink sealing caps. The required additional sealing caps of sufficient quantity shall be supplied for use for testing during laying and jointing at site and to seal spare lengths of cable.

The packing should be able to withstand the rigors of transport.

The following information in bold letters in English shall be painted on the flanges.

(i) Name and address of the Manufacturer, Trade name/Trade Mark/Brand.
(ii) Size of cable (cross section) rated voltage, standard, insulation, cable code, drum number, year of manufacture.
(iii) Length of cables (metres).
(iv) Direction of Rolling.
(v) Net weight (in Kg).
(vi) Gross weight (in Kg).
(vii) Purchase order reference.

Note: a. Economic drum length shall be got approved from the owner during the survey of route by the successful bidder and inner drum diameter shall not be less than 20 D.

b. Each cable end shall be hermetically sealed by means of metal cups using wiping lead so as to protect the cable from moisture penetration during transit, storage and laying. Pulling tension shall be furnished by the successful bidder.

c. The vendor shall be responsible for any damage to the cables during transit due to cable or reels not having been properly fastened, packed and secured.

d. Two Nos. of swivels of suitable capacity shall be supplied along with the first batch of cables free of cost.

e) The maximum weight of cable along with drum to be furnished by the successful bidder before execution of works.

Handling and Storage:

All accessories and spares shall have a minimum shelf life of 10 years, detailed instructions for storing accessories and all equipments which are supplied by the vendor shall be indicated.

15.00.0 DESPATCHES:

No dispatches shall be made without approval from the Owner to the test certificates. All dispatches shall be made to the consignees intimated by the owner.

16.00.0 CABLE LENGTHS:

The correct total quantity, the number of drums, the length of cable on each drum shall be ascertained by the successful bidder from the owner, at the time of manufacture. This is in view of any change in the already finalized route plan, profile which may arise due to any unforeseen circumstances between the period of placing the order and commencement of manufacture.

17.00.0 DELIVERY AT STORES/SITE STORES:

The stores / site is located at Bangalore. All regulations governing the transport of goods by various modes of transport shall be observed by the contractor.

It will be the sole responsibility of the successful bidder to deliver the goods safely at the owner's stores / site stores, including handling and unloading etc.,

18.00.0 INSTALLATION:

18.01.0 SURVEY – ROUTE PLAN:

18.01.1 The bidders are requested to fully inform and acquaint themselves on the local site conditions, which have a direct bearing on the cost estimates and execution of the work.

The tentative cable route plan is furnished to the bidder, indicating roads, position of road crossings, railway crossings, drainage crossings etc., in the drawing enclosed with the bidding document. In case of Variations during actual survey or any deviations in quantity, payment would be made as per quantities executed as per actuals.

The successful bidder shall make a detailed survey of the cable route, by excavating the trial pits as warranted by the local conditions and prepare necessarydrawings. All relevant data, required shall be properly recorded and preserved forfuture use and to decide on requirements of:

- Cable delivery length per drum
- Proposed cable sections
- Location of joint bay positions

- Type and quantity of joints required
- Final cable route plans
- Design of cable ducts/trench for road crossings drainage crossings, railway crossings etc.
- Identify locations for bonding.
- Trench with brick masonry side wall and pre-cast reinforced concrete slabs.

The survey data on the cable route should also include recording of the information required for cable design, such as

- Type of soil along the cable route, soil resistivity
- Soil thermal resistivity, PH Value
- Sub soil water locations and other relevant information in designing the ducts and pipes for cable.

NOTE: The quantities executed will be paid at actuals.

18.01.2 LOCATION OF JOINT BAYS:

The location of the joint bays should be carefully decided to avoid, traffic hazards, collection of subsoil water and any possibility of flooding due to storm waters. The joint bays located should be easily accessible for inspection and tests.

18.01.3 CABLE LENGTH, SECTIONS:

The maximum and minimum delivery lengths of cable that can be supplied shall be furnished by the bidder in the tender.

The successful bidder shall carryout a final route survey, fix joint bay locations and finalize the sections and delivery lengths.

A tolerance of ±1% may be assumed while finalizing the actual cable length.

The work on installation and laying of cables will be taken up by the successful bidder only on approval of the route plans by the owner.

18.01.4 CABLE INSTALLATION RECORDS:

The route plan records / drawings, and the final route map drawings after installation and commissioning, should be furnished to the owner. Three transparencies and nine zerox copies each of route plan and 2) Final route map after installation shall be furnished. Soft copy of the same shall be furnished in CDs.

18.01.5 For preparation of cable route plans and cable records, relevant sections of Indian standards publication IS:1255, "Code of Practice for installation and maintenance

of power cable", or any other appropriate international standard may be referred for guidance.

18.01.6 SOIL THERMAL RESISTIVITY / SOIL RESISTIVITY:

The successful bidder shall investigate the soil characteristics along the cable route, at the required laying depths to evaluate the parameters governing the cable design. The thermal resistivity tests should be carried out at every 200M interval along the cable route and also at specified locations at the direction of the owner. At each location the thermal resistivity tests are to be taken at three different depths and two soil samples are to be taken for further laboratory analysis.

The laboratory analysis of the soil samples collected from the site should be conducted in detail, including soil identification, moisture content, density, organic content, critical moisture content of each soil type encountered along the route to arrive at the thermal resistivity values of the native soil.

The generally assumed value of the soil thermal resistivity may be taken as 150^0C Cm/w.

The OWNER anticipates the presence of soil strata at a few locations along cable routes with a soil thermal resistivity of more than 150^oC Cm/w.

However, the successful BIDDER shall be responsible to ensure that no derating of the cable will take place on account of variation in soil thermal characteristics. In consultation with the OWNER, the BIDDER shall analyse and indicate the appropriate backfill (STB – Soil Thermal Backfill) recommended. Bidder will have to design the trench optimally to take care of local site conditions. The maximum permissible soil thermal resistivity shall be limit to 120^oC Cm/w in fully dried condition out of the locally available materials to achieve maximum current capacity for the cable section used. BIDDER shall ensure that no derating of the cable takes place on account of soil/backfill thermal characteristics and that proper backfill is used.

In conformity with the above requirement, the BIDDER shall determine and advise on the following:

- Optimum design of trench to take care of local hot spots and methods to reduce effective Thermal resistivity value.

- The type of graded sand to be utilized by sieve analysis as one of the components of the STB backfill to obtain tight fit soil.

- The optimum Kaolinitic clay content in the soil to make it less porous and of high specific surface area for optimum moisture retentivity suitable for areas prone to moisture migration on account of low water table.

- The material and composition of thermal backfill will be finalized during detailed Engineering. Bidder shall be responsible for ensuring the best "effective" thermal resistivity.

Subsequent to completion of backfilling, in-situ measurements of soil thermal resistivity, dry cured density, void ratio, moisture and clay contents of the soil shall be carried out by the BIDDER along the cable routes at regular intervals mutually agreeable to the BIDDER and PURCHAER, using his own instruments as a quality check on the backfill employed and method of back-filling and detailed report shall be submitted by BIDDER.

However, the successful bidder shall carry out the required investigation and tests to evaluate and determine the soil resistivity and soil thermal resistivity along the cable route, at cable laying depth, to the satisfaction of the owner.

18.01.7 THERMAL BACKFILLS:

The successful bidder shall design, specify supply formulate, test and lay a suitable backfill, only if the owner desires and with the prior approval of the owner, if found necessary after the receipt of the route survey report for thermal characteristics of the soil.

18.02.0 Laying and installation of Cables:

18.02.1 General

The successful bidder shall carry out all activities connected with the laying and installation of the power cables, and completion of the work for which the project is intended and to the full satisfaction of the owner.

Notwithstanding subsequent changes/alterations in route/design, the bidders shall quote in their bid proposals for carrying out the cable installation work as per the specifications of the owner, which will be considered for bid evaluation.

However, alternate route/installation arrangements offered from the bidders, with clear justification for these alternatives, will be considered by the owner, if they

prove to be of a better and economical design and also the quoted bid value is the lowest.

18.02.2 Scope

This scope covers the proposed method of cable laying, in ground i.e., directly buried in ground with laying in ducts, pipes and in air. The excavation and construction of R.C.C., stone masonry, brick masonry ducts, laying of pipes for installing cable and also for the construction of jointing bays as per requirement of the field conditions.

The scope also includes supply of all requisite materials, labour, tools and plant like sand, brick, stones, steel, cement aggregate for reinforcement, pipes, joint and route markers and all other consumables required for the completion of this work.

The bidder shall insure for materials. The bidder shall handle, load, transport, unload and store all materials at site and arrange for security, till commissioning and handing over to the owner.

18.02.3 Drawings

The bidder shall prepare the drawings for the applicable field conditions of cable installation, like cables directly buried, in ducts, in road crossings, on drainage crossings, railway crossings, cable jointing bays, manholes if any, and furnish 6 copies of each to the owner for approval.

All works are to be executed only after due approval of the competent authority and under the supervision of the engineer in-charge.

18.02.4 Specifications

These specifications are intended for general description of quality, of materials and workmanship of finished work.

They are not intended to cover the minute details. The work shall be executed in accordance with the best modern practices, Indian standards (I.S.) and other relevant codes.

The specifications, referred to above are I.S. Standards relevant to Civil Engineering works and cable laying works.

The specifications shall be read in conjunction with the other parts of the bid documents.

The owner's decision shall be final on any issue in respect of installation.

18.02.5 Installation of U.G.Cables

Installation: The cables shall be laid generally in "directly buried in ground/in RCC cable duct in Trefoil touching formation to form 220 KV 3 single core, single circuit system. However, as per requirement of the field, the cables may also have to be laid;

- in ducts/trenches.
- in HDPE pipes in trefoil/horizontal formation (pipes to be filled with sand/suitable material after cabling).
- in Air at terminations.
- At varying depths due to obstructions.
- As per approved drawings.
- In HDPE pipes for railway crossing

18.02.6 Inspection, Storage and Handling

The successful bidder should take all necessary precautions for inspection of cables on receipt, and for the proper handling and storage. The successful bidder shall have his own arrangement for transporting the cables, materials, equipment to site and back to store.

The cables shall be stored on hard packed surfaces and protected from harmful weather conditions.

The cable drums shall be mounted and transported on only approved type cable drum conveyors. The cable should not be bent beyond permissible limits of the bending radius while laying and jointing.

18.02.7 Statutory Clearances

The installation of cables shall be as per established code of practice and fulfill the requirements of statutes. Obtaining all statutory clearances from other utility services, like telephones, water supply, power supply, Railways, National highways, Bengaluru Mahanagara Palike and other Local Administrative Authorities for road cutting etc., for laying the cable will be responsibility of the successful bidder.

All necessary approvals of the concerned authorities to be obtained before execution of the works by the successful bidder and necessary assistance will be rendered by the owner.

Charges to the civic/national highways/traffic/defence authorities/Railway/ Telephones/Water supply/Power supply/MahanagaraPalike and other Local Administrative authorities etc., as per their standard schedule of rates for grant of permission/approvals for trenching/laying pipes/laying cables etc., are to be paid by the successful bidder. These charges are reimbursable by the owner as per actuals, on production of valid vouchers.

18.02.8 Trench/RCC Cable duct

The cable trench/RCC cable duct work involves earth excavation for cable trench/Excavation and Construction of RCC cable duct, back filling and removal of excess earth from site. The work site shall be left as clean as possible after completion of the work.

The earth for construction of trench/RCC cable duct shall be excavated using manual and mechanical modes as per field conditions. Most of the roads are of asphalt surface and some are with cement concrete surface.

An air compressor with pneumatic drill or equivalent mechanical tool will be essential for the road crossings and railway crossings involve horizontal drilling i.e., Trench-less cutting wherever necessary.

Where paved footpaths are encountered, the pavement slabs shall be properly stored and reinstated. Identification markers of other services shall be properly restored.

The sides of the excavated trenches/RCC cable duct shall wherever required, be well shored up with timber and sheeting.

Suitable wooden barriers should be erected between the cable trench and pedestrian / motor way/railway to prevent accidents. The barriers could be made

out of Jungle Wood / Deal Wood Planks. These could be portable types of size 1.5M (long) by 1.2M (Height). These barriers should be painted with yellow and black or red and White coloured cross stripes. Warning and caution boards should be conspicuously displayed. Red lights as warning signal should be placed along the trench during the nights and any other requirements as per the traffic authorities directions.

The excavated material shall be properly restored immediately after laying the cable by mechanical compactness to avoid obstruction to public and traffic movement. The cable shall be laid immediately after formation of trenches. The bottom of the excavated trench should be levelled flat and free from any object, which would damage the cables. Any gradient encountered in trench/cable duct shall be gradual.

18.02.9 Cable Handling

The inspection of cable on receipt, handling of cables, paving out, flaking, cushioning with sand or sieved compacted native soil, back-filling, reinstatement of road surfaces, providing and fixing joint markers, route indicators, preparation of all chambers, sump holes and all necessary precautions that are required shall be carefully planned and in general conform to latest edition IS 1255 - 1983 or its equivalent.

18.02.10 Damage to Property

The successful bidder shall take all precautions during excavation of trench/RCC cable duct trial pits etc., to protect the public and private properties and to avoid accidental damage. Any damage so caused shall be immediately repaired and brought to the notice of the concerned and to the owner.

The successful bidder shall bear all responsibilities and liabilities and shall bear all costs of the damages so caused by him or by his workman or agents.

18.02.11 Cable over bridges:

Wherever the cable route crosses the bridges, the cables shall be laid in ducts.

18.02.12 Cable crossing open drains with long span

1) Wherever the cable route has to cross an open drain, with a long span, the cable shall be laid in suitable size ducts, or pipes, suitably jointed with collars. The entire duct system shall be designed as per civil engineering practice and shall be got approved by the concerned authorities and owner.

2) At places where the cables cross private roads, gates of residential houses or

buildings, the cables shall be laid in HDPE pipes.

18.02.13 **Cable route markers / cable joint markers.**

Permanent means of indicating the position of joints and cable route shall be fabricated supplied and erected as per drawings approved by owner.

Markers provided shall be as per the field requirement. If the route passes through open fields, markers should be conspicuously visible and above ground surface.

The marker should incorporate the relevant information: The name of the owner, voltage, circuit and distance of cable from the marker.

18.02.14 **Laying of Power Cables**

The 220 KV, single-phase cables shall be laid in Trefoil formation, forming one circuit laid in the trench/duct complying with all applicable standards as per drawings approved by the owner.

The cables shall be laid wherever required in HDPE pipes of ISI approved quality. When cables are laid in RCC hume pipes, the following points shall be taken care of.

If one cable (single phase) is laid through the Cement Concrete pipe, the CC pipe should not have reinforcement of steel rods.

The cable should occupy only 30-40 % of the area of the cross section of pipe.

The CC pipes shall be backfilled by sand after installing the cable.

The cables shall be protected by covering with a pre-cast RCC slab of approved design and marking throughout the length of the route.

18.02.15 Paving out the cable

The excavated cable trench/RCC cable duct shall be drained of all water and the bed surface shall be smooth, uniform and fairly hard before paving out the cable. The cable shall be rolled in the trench/RCC cable duct on cable rollers, spaced out at uniform intervals. The paving out process must be smooth and steady without subjecting the cable to abnormal tension. For this power winch, power roller – both straight and angle roller, may be used. The cable on being paved out shall be smoothly and evenly transferred to the ground after providing the cushion. The cables shall never be dropped. All snake bends shall be straightened. Suitable size cable stocking pulling eye shall be used for pulling the cable. While pulling the cable by winches or machines, the tension loading shall be by tension indicator andshall not exceed the permissible value for the cable. The cable laying shall be performed continuously at a speed not exceeding 600 to 1000 mtrs per hour.

The cable end seals shall be checked after laying and if found damaged shall immediately be resealed. Sufficient number of heat shrinkable cable end sealing caps shall be stocked at site stores, for testing and jointing work. The integrity of the outer sheath shall be checked after the cable is laid in position Bell mouth shall be used whenever the cables are drawn inside HDPE pipe, duct.

18.02.16 Flaking:

The cables shall be flaked and left with slight extra lengths at jointing bays for expansion and flexibility.

18.02.17 Sand Cushion:

The sieved sand cushion for the cables shall be provided as per the drawings. Sand covering shall be done by hand and in such a manner as to provide complete envelope for the cables and a good bedding for protection covers

18.02.18 Thermal Backfill:

Based on the evaluation of soil thermal resistivity along the cable route and after approval from the owner the successful bidder shall design, specify, supply, lay & monitor the installation of thermal backfill surrounding the cables.

18.02.19 Immediate Envelope To Cable

The option on the use of the material, which immediately envelops the cable viz.,

thermal backfill or sand or sieved native soil rests with the owner. The successful bidder shall seek prior approval on the use of the envelope material from the owner before execution of the works.

18.02.20 Prevention of damage due to sharp edges

After the cables have been laid in the trench/RCC cable duct and untill the cables are covered with protective covering, no sharp metal tool shall be used in the trench/RCC cable duct or placed in such a position that may fall into the trench/RCC cable duct.

Straight and curved (angle) rollers used shall have no sharp projecting parts liable to damage the cable.

While pulling through pipes and ducts, the cable shall be protected to avoid damage due to sharp edges. Bell mouth shall be used whenever the cables are drawn inside HDPE pipe, duct..

The cables shall never be bent, beyond the specified bending radius.

18.02.21 Road Crossings:

The road cutting work for cable trench/RCC cable duct whether cement concrete, asphalt or macadam road surface shall be taken after obtaining approval forcutting from the civic authorities, traffic police, telephone authorities and work should be planned to be completed in the shortest possible time. Whereever necessary the work shall be planned during night time or light traffic periods.

In the excavated trench across the road, the cables shall be laid in HDPE pipes, pipes are embedded in RMC (Ready mixed cement concrete) 1:2:4 proportions, excavation backfilled, compacted and the surface shall be redone in the shortest possible time as per the requirements of the civic authorities.

18.02.22 Footpath Cutting:

The slabs, kerbstones, on the roads shall be removed and reinstated without damage.

18.02.23 Reinstatement:

After the cables and pipes have been laid and before the trench is backfilled all joints and cable positions should be carefully plotted and preserved till such time the cable is energised and taken over by the owner. The protective covers shall then be provided, the excavated soil riddled, sieved and replaced. It is advisable

to leave a crown of earth not less than 50 mm and not more than 100 mm in the centre and tapering towards the sides of the trench.

The temporary reinstatement of roadways should be inspected at regular intervals, more frequently in rainy season and immediately after overnight rain for checking settlement and if required, then temporary reinstatement should be done.

After the subsidence has ceased the trench may be permanently reinstated and the surface restored to the best possible condition.

In case of the road surface being cement concrete, asphalt or tarred macadam, resurfacing shall be done as per the requirements of the civic authorities.

18.02.24 Jointing Bays:

The successful bidder shall identify the location of the joint bays after carrying out detailed survey of the cable route and excavation of the trial pits. The delivery lengths of the cables shall match the location.

The joint bays shall be of sufficient size to accommodate jointing of cables and constructed with RCC M20 Grade and Fe 415 Steel. It shall consist of RCC raft laid over PCC 1:4:8, RCC Retaining walls/Side walls and RCC cover slab with an inspection chamber. All exposed faces of raft, slab and side walls shall be plastered with 12mm thick Cement Mortar 1:4. At the bottom in a corner, a sumppit shall be made for bailing out water.
After completion of all the works, viz., construction of Jointing Bay, laying of cables, testing of cables/jointing etc., the jointing bay shall be backfilled with riddled sand.

The successful bidder shall submit an economical design and drawing of joint bay for approval of the owner.
All works shall be carried out in presence and supervision of the owner's engineer.

18.02.25 Railway Crossing:

The earth shall be excavated using an air compressor with pneumatic drill or equivalent mechanical tool for laying pipes for crossing of railway track after obtaining prior approval of railway authority. The work shall be planned to be completed within shortest possible time. The work shall be carried out as per the standard practice suggested by railway authorities.

18.02.26 Tools and Plant

The successful bidder shall have all necessary tools, plant and equipment to carry

out the survey and cable installation work.
The bidders are instructed to give all the details of equipment at their disposal, to carry out the work successfully and speedily.

18.03.0 JOINTING AND TERMINATING:

18.03.1 Jointing Of Cables

General: The cable jointing personnel and his crew shall have good experience in the type of joints and terminations that are used. The jointing work shall commence as soon as two or three lengths of cables have been laid. All care should be taken to protect the factory-plumbed caps/seals on the cable ends, and the cable end shall be sealed whenever the end is exposed for tests.

Jointing of cables in carriageways, driveways under costly pavings, under concrete or asphalt surfaces and in proximity to telephone cables, and water mains should be avoided wherever possible.

Sufficient over lap of cables, shall be allowed for making the joints.

The joint bay should be of sufficient dimensions to allow the jointers to work with as much freedom of movement and comfort as possible. Sufficient space should be kept below the cable to be jointed.
The joints of different phases shall be staggered in the jointing bay.

The cable jointing work should be necessarily got done only through well trained professional jointers.

Jointing work details

l) Uncoiling, cleaning, straightening and trimming of 220KV cable as required for jointing.
ii) Checking the cable inside the joint bay before cutting the cable, for any accidental damages due to re-excavation.
iii) Providing the joint tent, tools etc., at the site by the vendor.
iv) Erection of joint tent, (joint tents should be of metallic housing.
v) Electrification of the joint bay, arranging and fixing of air conditioners and maintaining them for the entire period of jointing (temperature inside the joint tents should be maintained below 25 deg C.)
vi) Transporting the required quantity of jointing kits from stores to site (Including link boxes)
vii) Dismantling the wiring, air conditioner etc.
viii) Dismantling the joint tent.

ix) Devolution of cable cut bits to departmental stores including transportation.
x) Providing security guards for joint bay.
xi) Cost of power for the entire period of jointing.
xii) Providing 2 Nos. 2 HP Diesel Dewatering pumps.

18.03.2 Sumpholes:

While jointing cables in water logged ground or under unforeseen rainy conditions, a sumphole should be made at one end of the joint bay, in such a position so that the accumulated water can be pumped or bailed out by buckets, without causing interference to the jointing operation.

18.03.3 Tents/Covers

Erection of Joint tent (Joint tent shall be of metallic housing) Electrification of Joint bay, arranging and Fixing of Air conditioners and maintaining them for entire period of jointing (Temperature of Joint tent should be maintained below 25 deg. C)

Providing sheath protection for earthing wherever necessary. All accessories and spares required shall be of satisfactory operation for 10 years and furnish the details of maintenance.

18.03.4 Precautions before making a joint:

The cable end seals should not be opened until all necessary precautions have been taken to prevent circumstances arising out of rainy/inclement weather conditions, which might become uncontrollable.

If the cable end seals or cable ends are found to have suffered damage the cables should not be jointed, without tests and rectification.

18.03.04A PERT CHART

Indicating time schedule for supply of cable and accessories and supervision of cable laying, testing and commissioning shall be furnished by successful vendor in consultation with the purchaser and should be got approved along with drum length approval. The schedule should be kept up by the vendor. Any delay in completing the work will attract penalty.

18.03.5 Measurement of Insulation Resistance:

Before jointing, the insulation resistance of both sections of cables shall be checked.

Before laying cable in the ground, the insulation resistance of each section shall be

measured.

18.03.6 **Identification:**

The identification of each phase shall be clearly and properly noted. The cables shall be jointed as per the approved design. Each cable shall have identification forphase at joint bays.

18.03.7 **Making a Joint**

Comprehensive jointing instructions should be obtained from the manufacturer of jointing kits and meticulously followed.

The materials used in the joints like ferrules, screen/sheath continuity bonds, lugs, etc., shall be of good quality and conform to standards.

The jointing tools shall be appropriate and as per the requirement of jointing EHV XLPE cables.

18.03.8 **Cable Terminations**

The cable terminations used are outdoor type/GIS plugin type.
The preparation of the cable end for installing the terminations and the precautions to be taken before fixing the terminations shall be followed as in the case of the cable jointing procedures.

The instructions furnished by the termination manufacturer shall be strictly followed.

At cable terminating end, the following provisions for supply and erections are to be included.

i) A sufficient length of spare cable shall be left in the ground, for future needs

ii) The rise of the cable, immediately from the ground shall be enclosed in minimum dia of 250 mm HDPE pipe to protect against direct exposure to the sun.

iii) The cable shall be properly fastened using nonmetallic clamps.

iv) Appropriate labels shall be fixed identifying the phase, circuit, Voltage and date of commissioning etc., on the cable supporting structure.

v) The sealing ends shall be mounted on pedestal insulators to isolate them from their supporting steel work.

vi) Protection from contact with the exposed metal work at the termination shall

be provided by resin bonded glass fibre shroud.

vii) Providing earth stations with all required materials like leads, connectors, earthing rods/pipes etc.

ACCESSORIES

Dust and humidity free enclosures complete with air conditioners and material handling equipment shall be used by the vendor.

All special tools including a set of jointers hand tools that are necessary to complete the joint/termination works shall be arranged by the vendor. Necessary power supply for jointing and termination works shall be arranged by the vendor.

The cost of consumables which are essential for satisfactory erection and commissioning shall be included.

Adequate quantity of consumable shall be supplied for completing the entire cable laying and jointing works.

Termination Work details:

1) Erection of termination structure.
2) Removal of cable from the trench, rerouting, cleaning straightening and trimming if necessary, checking the exposed cable before cutting the cable for any accidental damages due to re-excavation.
3) Providing of scaffolding pipes, clamps, wooden planks and tools for erection of termination.
4) Erection of scaffolding pipes/ providing crane for lifting 220KV cable and termination.
5) Lifting the cable up the terminal structure and positioning.
6) Transporting the termination kit from departmental stores (including link boxes)
7) Dismantling scaffolding work.
8) Transporting the above item back.
9) Devolution of cable cut bit to departmental stores including transportation.
10) Provision of security guard for the cable end/ termination.
11) Providing fire retardant paint for exposed portion of the cable and other related works.
12) Cost of power for the entire period of work.

18.03.9 Bonding of screen/sheath

The type of bonding i.e., single end bonding/both end bonding/cross bonding as recommended by the successful bidder, shall be adopted.

For one/both end bonding:

The screens at one/both ends, shall be brought out and solidly bonded/ or through SVL to the earth station through disconnecting type link boxes.

The link boxes, single-phase outdoor type with SVL at receiving end (with bye-pass arrangement for SVL) and without SVL at sending end shall be provided.

All accessories and consumables used in the termination should be of good quality and compatible with the cable.

For cross bonding:

Shall be executed as recommended in Clause No.7.04.03.

18.03.10 Connection of Radial Water Barrier and Cable Screen

If the metallic radial water barrier is insulated from the metallic wire screen a connection suitable to carry the currents occurring during operation must be

installed between metallic radial water barrier of the cable and metallic wire screen in joints and sealing ends.

18.03.11 Erection of Cable Terminating Structure.

The terminating structure should be designed as per the requirement of the cable end sealing, offered by the bidder.

The mounting structure shall have good cement concrete foundation as per civil engineering norms/ Approved drawings.

After fixing the end termination, the cable shall be fixed to the support, with nonmagnetic material clamps to the required height securely. The drawings of station structure and equipment for connection of cable will be furnished by the owner.

18.03.12 Surplus Cable

The wastage of cable beyond practically required permissible limits should be avoided.

For any valid reason if there is a surplus cable, it shall be returned to the owner's store.

Approved good quality sealing caps, heat shrinkable type of the correct size, shall be supplied for spare cut lengths of cable exceeding 100 M length, to enable them to be properly stored for future maintenance purposes. The successful bidder shallbe responsible for the immediate sealing of such cut lengths and the cost of the sealing end etc., thereof shall be deemed to have been included in the contract price.

The successful bidder shall clean the completed cable route and shall remove all surplus and waste materials, empty cable reels etc., preferably the same day but not later than the next day after the particular work is completed.

18.04.0 CIVIL AND STRUCTURAL WORKS:

General : This specification deals in brief with the civil and structural works for cable laying.

a) The scope of civil works include earth excavation for cable trench & RCC cable duct and cable laying, removal of excavated earth, design, supply and provide plain & reinforced cement concrete for foundations of equipment, support

structures, back filling, dewatering of trenches. Design, supply and providing cable jointing bays. The design of RCC cable duct for laying the cable along the route and cable duct/pipe ducts for crossing drains, roads, railway lines etc., shall be suitably done and rates quoted, making provision for complete supplies and erection as per relevant schedules. It includes all connected civil works.

b) Design, fabrication and supply of galvanised steel structures for cable end terminations, mounting of earthing link boxes.

c) Supply of all consumables and sundry materials not included in the specifications in detail but are necessary to meet the intent of the project.

18.04.1 <u>Codes And Standards</u>

Unless otherwise stated, latest Editions of the following standards are applicable.

IS:1255	:	Installation and Maintenance of Power Cable.
IS:5820	:	Specification for pre-cast concrete cable cover.
IS:209	:	Quality of Zinc for galvanising.
IS:226	:	Structural Steel.

IS:456	:	Plain and Reinforced Cement Concrete.
IS:800	:	Use of structural steel in general building construction.
IS:2016	:	Plain washers.
IS:2633	:	Zinc coating on Galvanised Steel.
IS:3063	:	Spring washers.
IS:5358	:	Hot Dip Galvanised coating on fasteners.
IS:6639	:	Hexagonal Bolts for steel structures.

Any other equivalent International/National Standard.

18.04.2 **Excavation**

The specification covers excavation for cable trenches, ducts, structural foundations, jointing bays.

The successful bidder shall control the grading in the vicinity of all excavations so that the surface of the ground will be properly sloped or diked to prevent surface water from running into the excavated area during construction.

The excavation shall include the removal of all materials required to execute the work properly and shall be made with sufficient clearance to permit the placing,

inspection and setting of forms and completion of all works for which the excavation is done.

The sides and bottoms of excavation shall be cut sharp and true. Under cutting shall not be permitted. Earth sides of excavation shall not be used in lieu of form work for placement of concrete unless authorised by the Engineers of the owner where the limitations of space for large excavation necessitates such decision.

18.04.3 Quantities

The bidder shall indicate the ceiling volumes/quantities for excavation and RCC works and Steel structure works, wherever specifically indicated.

18.04.4 The bidder shall quote unit rates for the items of works. He shall also quote the total price for each of the works.

18.04.5 The quoted price shall also include supply of all material, transportation charges, taxes, duties, octroi and toll, labour, construction plant and equipment and fixtures, fittings and all temporary and permanent works necessary for satisfactory completion in all respects.

18.04.6 The measurements of various civil works shall be jointly recorded; by the successful bidder and the Engineer-in-charge of the owner and duly certified.

18.04.7 When machines are used for excavation the last 300mm. before reaching the required level shall be excavated by hand or by such equipment that will leave the soil at required final level in its natural condition.

18.04.8 The bottom of the excavation shall be trimmed to the required level and when carried below such level by error, shall be brought to level, by filling with lean concrete of 1:4:8 mix, at successful bidder cost.

18.04.9 If the successful bidder is directed by the Engineer-in-charge of the owner to excavate to a lower level than that indicated on the drawing, such additional excavation shall be paid for at the applicable unit rates provided in the tender.
The rates shall be firm irrespective of increase in quantities to any extent. The bidder is bound to carryout any Non-tendered items of work required for completion of the task. For such items of work the applicable KPWD /MWSR schedule of rates, Data rates or derived rates whichever found appropriate will be allowed.

18.04.10 The successful bidder shall be responsible for his estimates, assumptions and conclusions regarding the nature of the materials to be excavated and difficulty of making and maintaining of required excavations and performing the work

required as shown on the drawing and in accordance with these specifications. Cofferdams, sheeting, shoring, bracing, draining, dewatering etc., shall be furnished and installed as required and the cost thereof shall be included in unit rate quoted for the item of excavation. The successful bidder shall be held responsible for any damage to any part of the work and property caused by collapse of sides of excavation. The materials can be salvaged if it can be done withsafety for the work and structure and as approved by the Engineering-in-charge.

However, no extra claim shall be entertained for material not salvaged or any other damage to successful bidder property as the results of the collapse. He shall not be entitled to any claim for redoing the excavation as a result of the same.

18.04.11 All excavation for installation of underground facilities shall be open cuts.

18.04.12 The excavation for foundation where specified shall be carried out atleast 75mm. or as specified in relevant drawing below the bottom of the structure concrete and then be brought to the required level by placing lean concrete of 1:4:8 Mix or as specified with aggregate of 40mm. nominal size.

18.04.13 When the excavation requires bracing, sheeting, shoring, or strutting etc., the successful bidder shall submit to the Engineer-in-charge drawings showing arrangement and details of proposed installation and shall obtain the approval from the Engineer-in-charge before proceeding with the work.

18.04.14 The successful bidder shall have to constantly pump out the water collected in the pits, trenches, due to rain, sub-soil, springs etc., and maintain dry working conditions at no extra cost to the owner.

18.04.15 **Measurement Of Excavation:**

The measurement, for the payment of earth excavation will be based on volume calculations of pit/trench. The unit of measurement shall be cubic meters. Nothing extra would be payable for slopes, shoring, strutting, etc., irrespective of whatever is provided. If directed by the Engineer-in-charge, the excavation shall be done on the slopes from slope stability point of view at no extra cost to the owner.

18.04.16 Carriage of excavated soil beyond a lead of 50 mts per lift of 1.5 mts.

18.04.17 **By manual labour:**

The excavated earth for disposal purpose beyond 50 mts and upto 300 mts shall be carried by manual labour. If directed by the Engineer-in-charge, this earth shall be used for back filling purpose. The rate for disposal of earth by manual labor upto 300 Mtrs shall be included in the excavation item and no extra rate for the same is admissible.

18.04.18 **By Mechanical Transport:** The successful bidder shall arrange to transport the surplus earth and soft/hard rock, left over after back filling the trench up to the required level (with watering and compaction) and disposal of earth by manual labor, by Mechanical means, to the disposal point of the local bodies with all leads and lifts and as directed by the Engineer-in-charge. It shall however be ensured that no soil is stacked in excavated area. Location where the soil is to be stacked/disposed shall be as directed by the Engineer-in-charge. However the successful bidder shall take all precautions at the site of excavation, for keeping the free flow of vehicular and human traffic and to avoid inconvenience in general.

The soil transported for disposal, shall be stacked and leveled neatly and dressed.

The rate for this item shall include loading, carriage, unloading, stacking and dressing etc., complete.

18.04.19 In no case the excavated soil shall be stacked upto to the distance of 1.5 mts from the edge of excavation or one third the depth of excavation whichever is more.

18.04.20 **Lead And Lift:**

The rates quoted for all items of work shall include all lifts and leads whenever applicable unless otherwise specified.

18.04.21 **Excavation and measurement in Hard Rock:**

Blasting in hard rock shall be done as per IS: 4081 (latest Edition). The hard rock excavated shall be stacked, measured and reduced by 40% for voids. Premeasurement of rock is to be recorded when measured on section. The quantity whichever is less shall be paid.

At locations where, open blasting can not be taken up due to site conditions, controlled blasting or removal of rock by chiseling & wedging shall be resorted to. The rate for excavation of hard rock shall include its removal by all the types referred to, appropriate to the site conditions.

18.04.22 **Backfilling Materials:**

The backfilling of excavated trenches/RCC cable duct & around foundation shall consist of one of the following materials as the Engineer-in-charge may direct in each location.

i) Selected sieved earth from excavated soil.
ii) Selected sieved earth brought from borrowed area.
iii) Sand filling (sieved).

NOTE: Sieved sand shall be strictly used for all the works.

Filling shall be done after the concrete or masonry work has fully set and its curing completed.
The successful bidder shall fill in and around any work untill it has been properly reinstated and approved by the Engineer-in-charge.

18.04.23 **Backfilling for cable trench**:

Backfilling shall be done in horizontal layers of thickness not exceeding 300mm thickness, free from pockets with careful watering where necessary for compaction. The backfill shall be riddled earth free from materials likely to cause damage to the cables.

The thermal backfill surrounding the cable shall be as per the design approved, by the owner.

18.04.24 **Measurements**:

Payments for back filling shall be based on the volume of consolidated fill. This

volume shall be derived from the difference between the volume of excavation and that of the structure (Concrete work, sand filling), or trench as the case may be.

18.04.25 **Specification For Cement Concrete**:

For the cement concrete, plain or reinforced for general use, requirement of concrete for nominal mix, strength and quality, pouring at all levels, form works, protection covering, finishing, add mixtures, inserts, curing etc., the provisions of the latest revision of IS:456 shall be complied with, unless permitted otherwise by any other Indian Standard Codes, shall form the part of the specification to the extent applicable within specification. The cement used shall comply with IS:269. The metal (Jelly) used in PCC/RCC shall be properly graded and machine mixed.

18.04.26 Curing And Protection Of Concrete:

All fresh concrete shall be covered with the layer of an absorbent material and kept constantly wet for a period of seven days or more from the date of placing concrete. The immature concrete shall be protected from the damages and contamination, that would impair the strength of the concrete.

18.04.27 Precast RCC Items:

The concrete mix for the various types of precast units shall conform to IS:456. The aggregate shall be mixed by weight and water cement ratio shall be controlled to obtain the dense concrete and the strength required. The reinforcement shall be as per the design approved. The curing shall be carried out for the period of seven days from the date of casting, and the precast element shall be cured by flooding with water of minimum 25mm. depth over the element for the period mentioned above.

All the precast element shall be marked, appropriately as specified.

18.04.28 Masonry Work:

Stone masonry and Brick (Table mould) masonry work wherever required shall be carried out by the contractor. The associated materials for masonry work like stones, bricks, sand etc., shall be of approved quality. The construction shall comply with accepted norms and standards.

18.04.29 Plaster: Plastering shall be done with cement and sand mortar, 1:4 by volume with clean sand. All plaster work shall comply with IS:1661.

Materials for plaster such as cement, sand, water shall conform to standards.

18.04.30 Mounting Structures:

The mounting structure include the supports for cable end boxes, link boxes and any other structure required for the intent of the contract.

All steel sections used shall be free from all imperfections, mill scales, slag intrusions, laminations, fillings, rust etc., that may impair their strength, durability and appearance. All materials shall be of tested quality only unless otherwise permitted by the owner. The structures shall be fabricated by the contractor.

18.04.31 Foundation:

Foundations for mounting structures in cement concrete shall be provided as per approved drawings by the Engineer-in-charge.

18.04.32 Bolts Nuts and Washers:

Standard bolts, nuts and washers shall be used in all works. These should be galvanised in accordance with IS:5358.

18.04.33 Painting:

Outdoor Kiosk for link boxes etc., shall be painted with anticorrosive paint and red oxide as primer and two coats of enamel paint. the boxes should be appropriately labelled as per installation at site regarding the Sl. No. location, type caution board/Danger Board. etc.

18.04.34 Materials Used In Cable Laying:

Specification in brief on the materials used in installation of the 220 kV underground cables, like RCC precast cable protection covers, precluded cement concrete blocks for cable route/joint indication, cable and mounting structures, joint bays, earthing and other miscellaneous materials are given below. All materials shall conform to relevant standards, and shall be approved by the Engineer.

18.04.35 RCC Precast Cable Protection Covers:

These should be pre casted as per the approved design and drawing. The reinforced cement concrete should be M20 grade (1:1.5:3 proportion) with 20 mm. and down size coarse aggregate and steel reinforcement (Fe 415 grade) shall be used and cured as per civil Engineering Standards. Cable Route Markers/Joint Markers:

Permanent and durable type, cable route markers/ joint indicating blocks should be provided as per the design supplied by the owner.

The cement concrete block should be made by the wet process and the concrete shall consists of one part cement two parts sand four parts aggregate of size 20mm.and down.

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18.04.36 <u>Pipes</u>:

HDPE pipes of ISI Mark, 250mm dia and above, 20 mm thickness approximate, of good quality shall be used for formation of cable ducts. All sundry materials like coupling, collars, caps to cover the pipe ends before cable is pulled in shall be provided.

Hume pipes and accessories conforming to IS shall be used if required. Reinforced hume pipe shall not be used for laying single core power cable, in one cable per pipe arrangement.

Stoneware pipes, salt glazed of good and approved quality shall be used.

Hume pipes without steel reinforcement, stoneware pipes, HDPE pipes can also be used where the cable passes through the passage or drive ways of public and private buildings.

In case of pipe – the size of the pipe shall be at least 30 to 40% more than size of cable. The pipe joint shall be done by using proper sleeves so as to get tight fitting. Suitable steel rope will be drawn in pipe to pull the cable. Before drawing the cable, wire brush to be drawn through pipe to clean the burrs and steel ball (sphere) shall be pushed through pipe to know whether pipe is smooth for drawing the cable.

18.04.37 <u>Supporting Structure For Cable And Cable End Terminations</u>:

The bidder shall quote for unit prices for support structure for each single core cable to suit the end termination supplied by him. The bidder shall design and furnish the details and drawings.

These support structures shall be fabricated out of galvanised steel pipe to IS:1239 or they shall be fabricated out of galvanised mild steel sections, such as channels, I-beams etc., conforming to IS:226, pipes if used for fabrication of the structure shall not have any joints.

The height of the structure shall be such that the terminal connection to receive the owner's ACSR Double Drake/Moose conductor/63 mm. Diameter, IPS aluminium pipe is approximately at a height of 4.5 meters. The successful bidder shall be furnished with relevant drawings by the owner.

18.04.38 The supporting structure shall be suitable to withstand, the wind pressure, seismic forces and the short circuit forces, etc., and the design shall be with an adequate factor of safety as specified in I.E. rules 1956.

18.04.39 The bidder shall furnish the design and fabrication drawings, foundations, foundation anchor bolts, design calculations etc., of these structures.

18.04.40 <u>Terminal Connectors</u>:

The terminal connector/clamps shall be suitable for connection to 63-mm diameter IPS aluminium pipe or double Drake/Moose ACSR conductor. The terminal connector shall be of bimetallic type to connect the terminal of the cable end to the aluminium bus pipe or ACSR conductor.

The type and size of the connector will be confirmed to the successful bidder.

The connector/clamp shall be designed to overcome:

i) Galvanic Corrosion.
ii) Thermal Cycling.

The current carrying capacity of the connector/clamps shall be greater than the maximum capacity of the power cable.
The terminal clamp shall be free from burrs, voids and blowholes.

The terminal clamps shall have passed tests for short circuit current capability and temperature rise.

18.04.41 <u>Sand</u>:

Sand supplied for backfill shall be river sand, free from flakes, dust, earth, organic matter and large pebbles and stones and should be free from any chemical contaminants likely to have corrosive action on the cable coverings.
The sand should be sieved through a mesh to remove all large stones and pebbles.
The sand shall be properly graded and shall conform to IS:383 for concreting work.
The owner will decide on the requirement of the use of sand depending on the availability of the excavated earth to be used for backfill.

The sand should be used with the approval of the owner as a backfill.

18.04.42 **Earthing:**

The earthing system required is for the

i) Earthing of all non-current carrying metal parts and
ii) Earthing system for cable screens/sheath bonding at terminations and at all others places wherever required.

The latest editions of the following standards and codes are applicable.

i)	IS:3043	:	Code of practice for earthing.
ii)	IS:2309	:	Code of practice for the protection of building and allied structures against lightning.
iii)	Indian Electricity Rules 1956	:	Provision of Rules on EHV systems.
iv)	IEEE-80	:	Guide for safety in sub-station grounding.

All equipment, supporting and mounting structures of the installation shall be bonded together and connected by separate and distinct conductor to earth electrode.

18.04.43 **Earth conductor:**

The earth conductor shall be of GI flat, of size 50 x 6 mm. size and shall be protected against mechanical damage and corrosion. The connection of the earth continuity conductors to earth bus and earth electrodes shall be strong, secure andsound and shall be easily accessible.

18.04.44 **Pipe Earth Stations**:

The pipe earth electrodes shall be of cast iron in conformity with IS:3043, buried vertically and the pit filled with alternate layers of charcoal, salt and earth. The earth lead shall be properly fastened with brass bolts nuts and connection shall be enclosed in a masonry chamber. The chamber shall be provided with a RCC inspection cover.

18.04.45 The connection between the earthing terminal of equipment and earth electrode shall be made by short and direct earthing lead, free from kinks and splices.

18.04.46 The distance between any two electrodes shall not be less than, twice the length of the electrode.

18.04.47 All joints shall be covered with suitable compound to protect against corrosion.

18.04.48 Earthing connections with equipment earthing terminals shall be of bolted type. The contact surfaces shall be free from scale, paint, enamels, grease, rust or dirt. Two bolts shall be provided for making each connection. The bolted connections after being checked and tested shall be painted with anticorrosive paint or compound.

18.04.49 Welds and brazed joints shall be treated with red lead and afterwards coated with bitumen compound to prevent corrosion.

18.04.50 Steel to copper connection shall be brazed type and shall be treated to prevent moisture ingress.

18.04.51 The resistance of the welded joint shall not be more than the resistance of equivalent length of the conductor.

18.04.52 All welded joints shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature.

18.04.53 Arc welding with large diameter conductor shall be done with low hydrogen content electrodes.

18.04.54 Bonding Of Cable Screens/Sheath:

Each single phase cable shall have a separate earth for the screen earthing.

The system short circuit level is 50 kA for 1 Sec. The earthing lead at solid earth positions shall be single core, 400 sq.mm copper conductor, PVC insulated 6.6 KV voltage grade Cable.

18.04.55 **Earth Tests**:

Tests on earths shall be carried out by the successful bidder for testing the effectiveness of earth resistance of electrodes and the results furnished to the owner.

19.00.0 TESTING COMMISSIONING, TYPE/ROUTINE TESTS ON CABLES as Per Applicable IEC.