BHARAT HEAVY ELECTRICALS LIMITED
TRANSMISSION PROJECTS ENGINEERING MANAGEMENT

DOCUMENT No.	**TB-399-510-011**	Rev. No.	00		Prepared	Checked	Approved
TYPE OF DOC.	**TECHNICAL SPECIFICATION**			**NAME**	**AA**	**SKS**	**SKS**
TITLE				**SIGN**	-Sd-	-Sd-	-Sd-
1.1 kV Aux Power & Control Cables				**DATE**			
				GROUP	TBEM	**W.O. No**	87007
CUSTOMER	Tamil Nadu Transmission Corporation Limited (TANTRANSCO)						
PROJECTS	400/230-110kV Substation at Vellalaviduthi						

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Rev No.	Date	Altered	Checked	Approved	REVISION DETAILS			
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SECTION 1
SCOPE, SPECIFIC TECHNICAL REQUIREMENTS AND QUANTITIES

1.0 SCOPE

This Specification covers the requirements of design, manufacture, testing at manufacturer's Works, packing, supply, and delivery at site of 1.1 kV Aux Power & Control Cables as listed under this specification. This section covers the specific technical requirements of 1.1 kV Aux Power & Control Cables. This constitutes minimum technical parameters for the above item as specified by the customer (TANTRANSCO). The offered equipment shall also comply with the General Specification for the project as detailed under section-3 of this specification.

In case of any conflict between the technical details mentioned in this section and the remaining sections of this document, then Section-1 shall prevail and is to be considered as binding requirement.

The specification comprise of following sections:

Section-1: Scope, Specific Technical Requirements and Quantities.

Section-2: Equipment Specification.

Section-3: Project Details and General Technical Requirements.

Section-4: Guaranteed Technical Particulars

Section-5: Checklist.

Note: The term 'Owner' appearing in this specification shall refer to TANTRANSCO, the term 'Purchaser' shall refer to BHEL and the term 'Contractor' shall refer to the successful Bidder.

1.1 THE EQUIPMENT IS REQUIRED FOR THE FOLLOWING PROJECT

Name of Customer : TAMIL NADU TRANSMISSION CORPORATION LTD.

Name of the Project : 400/230-110kV SS at VELLALAVIDUTHI

LOA NO. : CE/TR/SE/TR_IV/EE3/AEE1/F.T-2004/LOA.2966/D.080/2018 DT 28.06.2018
Refer Section - 3 for Project Details and General Specifications.

1.2 SPECIFIC TECHNICAL REQUIREMENTS

1.2.1 As per Annexure-1 (TANTRANSCO specification, 10 pages).

1.2.2 (a) **Strip armouring method (a) mentioned in Table 5, Page-6 of IS: 1554 (Part 1) - 1988 shall not be accepted for any of the cables.**
(b) **Strip armouring method (a) mentioned in Table 6, Page-6 of IS: 7098 (Part 1) - 1988 shall not be accepted for any of the cables.**

1.3 QUANTITIES

Sl. No.	Type of LT Cables	Quantity (kM)
A.	**Type of LT HR PVC Control Cables**	
1	2C x 2.5 sq mm HR PVC/Copper, Armoured	8
2	4C x 2.5 sq mm HR PVC/Copper, Armoured	40
3	8C x 2.5 sq mm HR PVC/Copper, Armoured	6
4	14C x 2.5 sq mm HR PVC/Copper, Armoured	40
5	20C x 2.5 sq mm HR PVC/Copper, Armoured	30
6	28C x 2.5 sq mm HR PVC/Copper, Armoured	20
7	4C x 4 sq mm HR PVC/Copper, Armoured	50
8	8C x 4 sq mm HR PVC/Copper, Armoured	35
B.	**Type of LT Auxiliary HR PVC Power Cables**	
9.	2C x 16 sq mm HR PVC/Copper, Armoured	1.55
10.	2C x 25 sq mm HR PVC/Copper, Armoured	0.5
11.	2C x 35 sq mm HR PVC/Copper, Armoured	1.5
12.	4C x 16 sq mm HR PVC/Copper, Armoured	1
13.	3.5C x 185 sq mm HR PVC/Copper, Armoured	0.25
C.	**Type of LT Auxiliary PVC Power Cables**	
14.	4C x 25 sq mm PVC /Aluminium, Armoured	2.5
D.	**Type of LT Auxiliary XLPE Power Cables**	
15.	4C x 120 sq mm XLPE/Aluminium, Armoured	2.5
16.	4C x 240 sq mm XLPE/Aluminium, Armoured	2.5

Note:

1) **The overall contract value may vary by +/- 30%.**

2) **Manufacturing Clearances may be given in two lots (Lot-I and Lot-II) as per actual site requirement.**

All Control and Power Cables shall be supplied in drum length of 1000 m. For power cable with conductor cross sectional area 300sqmm and above may be supplied in 500m drums.-Owner shall have the option of rejecting cable drums with shorter lengths. The cable length per drum is allowed a tolerance of ±5%. However, the total quantity of cables after taking into consideration of all cable drums for each size shall be within the tolerance of ±2%.

1.4 TESTS

Cables shall conform to type tests including additional type tests as per technical specification and shall be subject to routine & acceptance tests in accordance with requirements stipulated under respective sections.

The reports for all type tests and additional type tests as per technical specification shall be furnished by the bidder along with the tender documents.
The bidder will conduct the routine tests on each drum length. All the type and acceptance tests shall be conducted as per specification and relevant standards/ approved MQP. These tests will be witnessed by owner/purchaser/purchaser's representatives.

All type tests as per relevant IS/IEC latest amendments and as per this TS shall be performed **on each type and size of cables** as a part of acceptance tests & price for conducting the same shall be included in the offered price for individual cables.

1.5 QUALITY PLAN

The manufacturer shall carry out contract works in accordance with sound quality management principles which shall include items such as controls which are necessary to ensure full compliance to all requirements of the specification & applicable international standards. These quality management requirement shall apply to all activities during design, procurement, manufacturing, inspection, testing, packaging, shipping, inland transportation, storage, site erection & commissioning. Manufacturer shall submit detailed Quality Plan for BHEL / customer's approval.

1.6 PROJECT TITLE BLOCK (To be incorporated in all documents during contract stage)

CUSTOMER	TAMIL NADU TRANSMISSION CORPORATION LIMITED (TANTRANSCO)				
PROJECT	**400/230-110 kV Substation at Vellalavidhuthi**				
CONTRACT NO	LOA No. CE/TR/SE/TR IV/EE3/AEE1/F.T-2004/LOA2966/D080/2018, dt. 28.06.2018				
BHEL P.O. No.		PROJ. DOC. No.		REV. No.	
CONTRACTOR	**BHARAT HEAVY ELECTRICALS LIMITED**				
VENDOR'S STANDARD TITLE BLOCK					

SECTION - I
ANNEXURE - I

SECTION - 19

ARMOURED COPPER CONTROL CABLES (HR PVC Cu)

The cable supplied shall be as per IS - 1554/PART I /1988 WITH AMENDMENTS UPTO DATE

Sl No	Description	
1	Voltage	1100v
2	Purpose	use in substation for supplying Power to equipments (AC 230 V/ DC 110 V/ 220 V) to be laid directly under earth / in cable ducts
3	Conductor sizes and no. of cores	As per schedule of materials
4	Conductor material	Plain annealed , high conductivity copper complying with IS - 8130/1984 with amendments up to date
5	Formation of conductor	Multi stranded circular shaped conductor as per the relevant ISS. Minimum 7 strands irrelevant to area.
6	No. of wires in each Conductor	As per IS 8130/1984 with amendments upto date as per the Schedule of materials.
7	Resistance of conductor at 20 Degree C	As per IS 8130/1984 with amendments upto date.
8	Materials and Thickness of core insulation	PVC Compound of Type - C as per IS - 5831 / 1984 shall be extruded over conductor Recycled granules should not be used for insulation Thickness should be as per IS-1554/part 1 / 1988 with amendments upto date.
9	Flexibility of Conductor	Class 2 of IS 8130 / 1984 with amendments upto date
10	Colour identification of cores	To conform to colour scheme as per IS - 1554/Part I/1988 with amendments up to date.
11	Laying of cores	The outer most layer of cores shall be laid up together with right hand lay & the successive layers shall be laid with opposite lay as per IS-1554 part I / 1988 with amendments upto date & shall be provided with non hygroscopic material wherever necessary.

12	Materials and thickness of sheath.	The laid up cores shall be inner Sheathed with extruded PVC compound of type ST2 as per IS - 5831/1984 with its amendments upto date. The inner sheath shall fit closely on the laid up core & it should be possible to remove it without damage to insulation on individual cores. Recycled granules should not be used for sheathing.The thickness of inner sheath shall conform to IS -1554 / PartI/1988 with amendments upto date
13	Armouring	The armouring shall be provided over the inner sheath in left hand lay, as closely as practicable with galvanised steel wires / strips conforming to IS - 3975 / 1988 (II revision).The dimensions of the armouring shall conform to IS - 1554 / Part I / 1988 with amendments upto date.
14	Outer Sheath	The armour shall be outer sheathed with extruded black PVC compound of type ST2 as per IS - 1554 / Part I / 1988 with amendments upto date. Recycled PVC granules should not be used for Sheathing .The thickness of outer sheath shall conform to IS 1554/ PartI/1988 with amendments upto date.

NOTE:

Both inner and outer sheathing should be done by two separate processes only. Dual extrusion should not be done.

15.0 Embossment

1) "HR 85" Embossment shall be done as per IS 1554/Part I/1988

2) "T.N.E.B" Embossing shall be done for each meter throughout the length of cable.

16.0 CABLE LENGTHS:

The cable to be supplied should be in standard lengths of ~~500~~ 1000 meters with a tolerance of +/ - 5% in non returnable wooden drums. The last drum to be supplied for completion of the quantity ordered with allowed tolerance shall contain bit length of not less than 50% of the standard length specified. A total tolerance of +/- 5% of quantity ordered will be allowed to be supplied.

18.0 CABLING MATERIAL

17.1 CABLE TAGS AND MARKERS

17.2 Each cable and conduit run shall be tagged with numbers that appear in The cable and conduit schedule.

17.3The tag shall be of aluminium with the number punched on it and securely attached to the cable conduit by not than two turns of 20 SWG GI wire conforming to IS:280. cable tags shall be of rectangular shape for power cables and of circular shape for control cables.

17.4Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanized iron plate.

17.5Location of underground cable joints shall be indicated with able marker with an additional inscription cable joints.

17.6The market shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change in direction. They shall be located on both sides of road and drain crossings.

17.7Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry and at each end & turning point in cable tray/trench runs. Cable tags shall be provided inside the switchgear, motor control centers, control and relay panels etc. wherever required for cable identification, where a number of cable enter together through a gland plate.

17.8Cable supports and cable Tray Mounting Arrangement

17.8.1The Contractor shall provide embedded steel inserts on concrete floors/walls to secure supports by welding to these inserts or available building steel structures.

17.8.3The supports shall be fabricated from standard structural steel members.

17.8.4Insert plates will be provided at an interval of 750 mm wherever cables are to be supported without the use of cable trays, such as in trenches. While at all other places these will be at an interval of 2000mm

17.9 Cable termination and Connection

17.9.1 The termination and connection of cables shall be done strictly accordance with cable and termination kit manufacturer's instruction drawing and /or as directed by the Owner.

17.9.2 The work shall include all clamping, fitting, fixing, plumbing, sold Drilling, cutting, taping, heat shrinking (where applicable), connecting to cable terminal, shorting and grounding as required to complete the job.

17.9.3 Supply of all consumable material shall be in the scope of Contractor.

17.9.4The equipment will be generally provided with undrilled gland plates for cables/conduit entry. The contractor shall be responsible for drilling of gland plates, painting and touching up. Holes shall not be made by gas cutting.

17.9.5Control cable cores entering control panel/ switchgear /MCCB /MCC / miscellaneous panels shall be bunches, clamped and ties with nylon strap or PVC perforated strap to keep them in position.

17.9.6The contractor shall tag/ferrule control cores at all terminations, as instructed by the owner. In panels where a large number of cables are to be terminated and cable identification may be difficult, each core ferrule may include the complete cable number as well.

17.9.7Spare cores shall be similarly tagged with cable numbers and coiled up.

17.9.8All cable entry points shall be sealed and made vermin and dust proof.

Unused openings shall be effectively closed.

17.9.9. Double compression type nickel plated (coating thickness not less than 10 microns) brass cable glands shall be provided by the contractor for all power and control cables to provide dust and weather proof terminations.

17.9.10. The Cable glands shall conform to BIS 6121. they shall comprise of heavy duty brass casting, machine finished and nickel plated, to avoid corrosion and oxidation, rubber components used in cable glands shall be neoprene and of tasted quality. Cable glands shall be of approved make.

17.9.11. The cable glands shall also be suitable for dust proof and weather proof termination. The test procedure, if required, has to be discussed and agreed to between owner and cable gland manufacturer

17.9.12. If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires modification, the same shall be carried out by the contractor, as directed by the owner.

17.9.13 Crimping tool used shall be of approved design and make.

17.9.14 Cable lugs shall be tinned copper solderless crimping type conforming to IS 8309 & 8394. Bimetallic lugs shall be used depending upon type of cables used.

17.9.15 Solderless crimping of terminals, shall be done by using corrosion inhibitory compound. The cable lugs shall suit the type of terminals provided.

17.10 Storage and handling of Cable Drums

17.11. Cable drums shall be unloaded handled and stored in an approved manner and rolling of drums shall be avoided as far as possible. For short distance, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.

1100 V , 4x25 SQ.MM AYFY UG POWER CABLE. (PVC-type A, AL)

1.0.	Requirement	:	1100 V rated 4x25 sqmm AYFY Power Cable, comprising of Multi-stranded shaped compacted Aluminium Conductor of grade H2/H4, PVC insulated, cores laid up, inner sheath of extruded PVC, galvanized steel strips armoured and PVC sheathed overall, conforming to IS.1554/Part-1/1988 with its amendments upto date and with ISI marking.
2.0.	Voltage Grade	:	1100 V
2.1.	Purpose	:	For use in LT distribution Network (cable to be laid in trench/directly underground)
2.2.	Conductor size and material	:	4x25 sqmm size and H2/H4 Grade Aluminium. Complying With IS. 8130/1984 with latest amendments
2.3.	Resistance of conductor	:	Maximum resistance at 20 degree Celsius shall be 1.20 ohm/km as per IS 8130/1984.
2.4.	Formation of conductor	:	Multistranded shaped Compacted conductor
2.5.	Number of strands per core	:	7 Nos.
2.6	Weight of bare Alu.Conductor	:	**Not less than 260 Kg per km for 4 cores.**
3.0.	Individual insulation	:	The Insulation shall be of type A, PVC compound of IS. 5831/1984 with its latest amendments up to date. (ie.) general purpose insulation for 70 degree Celsius operation and extruded from fresh PVC granules. Insulation with recycled PVC granules should not be used.
3.1.	Thickness of insulation	:	1.20 mm as per IS 1554/ Part I /1988.
4.0.	Colour identification of cores	:	Shall conform to colour schemes as per IS. 1554/ Part I/1988 with its latest amendments upto date. Red, Yellow , Blue and black.
4.1.	Laying up of core	:	The cores shall be laid up together with a suitable lay, the outermost layer shall have right hand lay and the successive layers shall be laid with opposite lay complying IS 1554 /Part-I/1988 with its amendments

upto date. Wherever necessary interstices shall be filled with non-hygroscopic material.

5.0. Innersheath: The laid up core shall be provided with inner sheath of PVC applied by extrusion. The PVC sheathing shall be extruded from FRESH PVC granules. Recycled PVC granules should not be used. The sheathing shall conform to Type ST.I., PVC Compound of IS 5831/1984 ie. general purpose sheath for 70 degree Celsius operation. It shall be ensured that it is as circular as possible. The inner sheath shall fit closely on the laid up cores and it should be possible to remove it without damage to insulation of individual cores. The thickness of inner sheath shall conform to clause 12.3 of IS 1554/ Part I/1988 with its latest amendments.

6.0. Armouring:

a. Galvanised Steel strip armour conforming to IS.3975/1979 with its latest amendments.

b. The armouring shall be applied over the inner sheath (common covering) as closely as practicable.

c. The number of armour strips so applied shall remain the same throughout (i.e.) in the inner end of the cable along the length of the cable and the outer end of the cable.

d. The direction of lay of the armour shall be left handed.

e. The dimension of the armouring shall conform to IS.1554/Part-I/1988 with its latest amendments.

7.0. Outer sheath The colour of the outer sheath shall be black. It shall be applied over the armouring. The thickness shall conform to clause 14.4 of IS 1554/Part I/1988 with its latest amendments. PVC sheathing shall conform to Type STI, PVC compound of IS.5831/1984 with its latest amendments ie.general purpose sheath for 70 degree Celsius operation & shall be extruded from fresh granules. Recycled PVC granules should not be used.

8.0. Cable lengths

- Cable shall be supplied in continuous drum lengths of ~~500~~ 1000 metres with a tolerance of plus or minus 3%
- A Quantity of cable, not exceeding 5% of the quantity ordered will be allowed to be supplied in non-standard length, but none of which shall be less than 250 metres.

- Plus or minus 2% of the quantity ordered will be allowed to be supplied more or less than the quantity ordered.

9.0. Manufacturer's Identification

The manufacturer's identification shall be provided throughout the length of the cable by embossing the following on the outer sheath at intervals of two metres approximately.

i. Trade Mark/ Manufacturer's name/ IS marking.
ii. Year of manufacture.
iii. Type of cable viz. AYFY.
iv. Voltage Grade as per relevant ISS.
v. Size of the cable (viz) 4 core 25 sq.mm
vi. Letters "TANGEDCO", ELECTRIC CABLE",
vii. The length of the cable shall be indicated sequentially along the length of the cable in each drum.

10.0 Packing

The cables shall be securely packed in non-returnable, well-seasoned wooden drum so as to withstand rough handling during transport by RAIL, ROAD, etc. and subsequent storage.

Following information shall be marked on the drum.

a. Reference to the Indian Standard ie. ref. IS 1554/Part-I/1988 with its latest amendments.
b. Manufacturer's name, brand name or trade mark
c. Type of Cable and Voltage grade
d. Number of cores
e. Nominal cross sectional area of the conductor.
f. Cable Code
g. Length of the cable in the drum
h. No. of lengths in the drum (if more than 1)
i. Direction of rotation of drum (by means of an arrow)
j. Approximate gross weight
k. Country of manufacture
l. Year of manufacture
m. The drum or cable may also be marked with ISI Certification Mark.

SECTION-VI
TECHNICAL
1100V , 4x240 SQ.MM A2XFY UG POWER CABLE. (XLPE, Al.)

1.	Requirements	:	1100V rated 4x240 sq.mm A2XFY Power Cable, comprising of Multi-stranded shaped compacted Aluminium Conductor of grade H2/H4, XLPE insulated, cores laid up, inner sheath of extruded PVC of type ST2, galvanized steel strips armoured and PVC of type ST2 sheathed overall, conforming to IS.7098/Part-1/1988 with its amendments upto date and with ISI marking.
2.	Voltage Grade	:	1100 V
2.1.	Purpose	:	For use in LT distribution Network, cable to be laid in Trench/directly underground.
2.2.	Conductor size and material	:	4x240 SQ.MM Size with H2/H4 Grade Aluminium. Complying With IS.8130/1984.
2.3.	Resistance of conductor	:	Maximum, resistance at 20 degree Celsius shall be **0.125 ohm/Km**, as per IS 8130/1984.
2.4.	Formation of Conductor	:	Multistranded shaped Compacted conductor
2.5.	Number of Strands per core	:	61 Nos.
2.6	Weight of bare Alu. Conductor	:	**not less than 2425 Kg / km(for 4 cores)**
3.0.	XLPE Insulation	:	1. The Insulation shall be extruded over conductor with cross linked Polyethylene (XLPE) conforming to Section VI of table of IS 7098/Part-I /1988 with its latest amendments up to date (i.e.) the insulation should be suitable for normal operation at 90 degree Celsius and with stand 250 degree Celsius during short circuit. The insulation shall be applied that it fits closely on the conductor. 2. The curing of XLPE insulation shall be processed with steam curing or Nitrogen gas curing so that the insulation is cured homogenously.
3.1.	Thickness of Insulation	:	1.70 mm.

4.0.	Colour identification of cores	:	To conform to colour schemes as per IS. 7098/Part I/1988 with its latest amendments upto date. Red, Yellow, Blue for main core. The neutral conductor core shall be black.
4.1.	Laying up of core	:	The cores shall be laid up together with right hand lay, complying IS 7098 / Part-I/1988 with its amendments upto date. The interstices shall be filled with non-hygroscopic material, wherever necessary.
5.0.	Inner Sheath	:	The laid up core shall be provided with inner sheath of PVC applied by extrusion. The PVC sheathing shall be extruded from FRESH PVC granules. Recycled PVC granules should not be used. Polyester transparent tape overlap over XLPE is preferable. The sheathing shall conform to Type ST2, PVC Compound of IS:5831/ 1984 ie. for 90 degree Celsius operation. It shall be ensured that it is as circular as possible. The inner sheath shall fit closely on the laid up cores and it should be possible to remove it without damage to insulation of individual cores. The thickness of inner sheath shall conform clause 12.3 table IV of IS 7098/Part I/1988 with its latest amendments.
6.0.	Armouring	:	a) Galvanised Steel strip armour conforming to IS.3975/1979 with its latest amendments. b) The armouring shall be applied over the inner sheath (common covering) as closely as practicable. c) The number of armour strips not less than 34 Nos so applied shall remain the same throughout (i.e.) in the inner end of the cable/along the length of the cable and the outer end of the cable. d) The direction of lay of the armour shall be left handed. e) The dimension of the armouring shall be 4.0x0.8 mm conforming to table VI of IS.7098/Part-I/1988 with its latest amendments.
7.0.	Outer Sheath	:	The colour of the outer sheath shall be black. It shall be applied over the armouring. The thickness shall conform to clause 14.3 table VIII of IS 7098/Part I/ 1988 with its latest amendments. PVC sheathing shall conform to

Type ST 2, PVC compound of IS.5831/1984 with its latest amendments for 90 degree Celsius operation & shall be extruded from fresh granules. Recycled PVC granules should not be used.

8.0. Cable Lengths : i) Cable shall be supplied in continuous drum lengths of - 500m metres with a tolerance of plus or minus 3%

ii) A Quantity of cable, not exceeding 5% of the quantity ordered will be allowed to be supplied in non-standard length, but none of which shall be less than 100 metres.

iii) A tolerance of Plus or minus 2% of the quantity ordered will be allowed to be supplied than the quantity ordered.

9.0. Manufacturer's identification : The manufacturers identification shall be provided throughout the length of the cable by embossing the following on the outer sheath at intervals of two metres approximately.

i) Trade Mark/ Manufacturer's name /IS Reference
ii) Year of manufacture.
iii) Type of cable viz. A2XFY.
iv) Voltage Grade as per relevant ISS.
v) Size of the cable (viz) 4 x240 sq.mm
vi) Letters **"TANGEDCO", "ELECTRIC CABLES"**
vii) The Length of the cable shall be indicated sequentially along the length of the cable in each drum.

10.0. Packing : The cables shall be securely packed in non-returnable, well-seasoned wooden drum so as to withstand rough handling during transport by RAIL, ROAD, etc. and subsequent storage. Following information shall be marked on the drum.

a) Reference to the Indian Standard ie. ref. IS 7098/Part-I/1988 with its latest amendments.
b) Manufacturer's name, brand name or trade mark
c) Type of Cable and Voltage grade
d) Number of cores.

e) Nominal cross sectional area of the conductor.
f) Cable Code
g) Length of the cable in the drum
h) No. of lengths in the drum (if more than 1)
i) Direction of rotation of drum (by means of an arrow)
j) Approximate gross weight
k) Country of manufacture
l) Year of manufacture
m) The drum or label may also be marked with ISI Certification Mark.

TECHNICAL

1100V , 4x120 Sq.mm ~~and 4x240 Sq.mm~~ LT UG CABLE. (XLPE, Al.)

1.	Requirements	1100V rated 4 x 120 sq.mm LT UG cable, comprising of Multi-stranded shaped compacted Aluminium Conductor of grade H2/H4, XLPE insulated,cores laid up, inner sheath of extruded PVC of type ST2, galvanized steel strips armoured and PVC of type ST2 sheathed overall, conforming to IS.7098/Part-1/1988 with its amendments upto date and with ISI marking.
2.	Voltage	1100 Volts
3.	Purpose	For use in L.T. distribution network, cable to be laid in trench/ directly underground.
4.	Conductor size	4 x 120 sq.mm.
5.	Conductor materials	Aluminium of H2/H4 grade complying with ISS 8130/1984, with latest amendments, if any
6.	Formation of conductor	Multistranded shaped compacted conductor
7.	No. of wires in conductor	4x120 sq.mm For the main core - 37 For the neutral core - 37 4x240 sq.mm

		Main core ... 61 Neutral core ... 61
8.	Resistance of the conductor	Maximum resistance at 20 degree Celsius shall be 0.253 ohm/Km for main and neutral conductors for 4x120 sq,mm and 0.123 for 4x240 sq.mm.
9.	XLPE insulation	(1) The insulation shall be extruded over conductor with cross linked polyethylene (XLPE) conforming to section VI of table of IS 7098/Part I/1988 with its latest amendments upto date (i.e) the insulation should be suitable for normal operation at 90 degree Celsius and withstand 250 degree Celsius during short circuit. The insulation shall be applied that it fits closely on the conductor. (2) The curing of XLPE insulation shall be processed with steam curing or Nitrogen gas curing so that the insulation is cured homogenously.
10.	Thickness of insulation	Minimum thickness of 1.2 mm for phase and neutral conductors for 4x120 sq.mm and 1.7 mm for 4x240 sq.mm.
11.	Colour identification of cores	To conform to colour schemes as per ISS 7098/Part I/1988 with its latest

		amendments upto date. Red, Yellow, Blue for main core and Neutral conductor shall be black.
12.	Laying up of core	The cores shall be laid up together with right hand lay complying with IS 7098/Part I/1988 with amendments upto date. The interstices shall be filled with non-hygroscopic material, wherever necessary.
13.	Inner sheath	The laid up cores shall be provided with inner sheath of PVC applied by extrusion . The PVC sheathing shall be extruded from FRESH PVC granules. Recycled PVC granules should not be used. Polyester Transparent tape overlap over XLPE is preferable.The sheathing shall conform to Type ST2, PVC Compound of IS 5831/1984 ie. for 90 degree Celsius operation. It shall be ensured that it is as circular as possible. The inner sheath shall fit closely on the laid up cores and it should be possible to remove it without damage to insulation of individual cores. The thickness of inner sheath shall conform clause 12.3 table IV of IS 7098/Part I/1988 with its latest amendments.
14.	Armouring	Galvanised Steel strip armour conforming to IS3975/1979 with its latest amendments. The armouring shall be applied over the inner sheath (common covering) as closely as practicable and should cover fully. The number of armour strips so applied shall remain the same throughout (i.e.) in the

inner end of the cable/along the length of the cable and the outer end of the cable. The direction of lay of the armour shall be left handed.The dimension of the armouring shall be 4x0.8 mm conforming to table 6 of IS.7098/Part-I/1988 with its latest amendments.

15. Outer sheath

The colour of the outer sheath shall be black. It shall be applied over the armouring. The thickness shall conform to clause 14.3 table 8 of IS 7098/Part I/1988 with its latest amendments. PVC sheathing shall conform to Type ST 2, PVC compound of IS.5831/1984 with its latest amendments for 90 degree Celsius operation & shall be extruded from fresh PVC granules. Recycled PVC granules should not be used.

16. Cable length

i) Cable shall be supplied in drum with continous drum lengths of 500/1000m metres with a tolerance of +/- 3%.

ii) A Quantity of cable, not exceeding 5% of the quantity ordered will be allowed to be supplied in non-standard lengths, but none of which shall be less than 250 metres.

iii) A tolerance of +/- 2% of the total ordered will be allowed to be supplied more or less than the quantity ordered.

17.	Manufacturer's identification	The manufacturers identification shall be provided throughout the length of the cable by embossing the following on the outer sheath at intervals of two metres approximately. i)Trade Mark/ Manufacturer's name/IS marking . ii) Year of manufacture. iii) Type of cable viz. A2XFY. iv) Voltage Grade as per relevant ISS. v) Size of the cable (viz) 4 x120 sq.mm vi)Letters "T.N.E.B.", ELECTRIC CABLES", vii) The Length of the cable shall be indicated sequentially along with the length of the cable in each drum.
18.	Packing	The cables shall be securely packed in non-returnable, well-seasoned wooden drum so as to withstand rough handling during transport by RAIL, ROAD, etc. and subsequent storage. Following information shall be marked on the drum. a) Reference to the Indian Standard ie. ref. IS 7098/Part-I/1988 with its latest amendments. b) Manufacturer's name, brand name or trade mark c) Type of Cable and Voltage grade d) Number of cores. e) Nominal cross sectional area of the

conductor.

f) Cable Code

g) Length of the cable in the drum

h) No. of lengths in the drum (if more than 1)

i) Direction of rotation of drum (by means of an arrow)

j) Approximate gross weight

k) Country of manufacture

l) Year of manufacture

m)The drum or label may also be marked with ISI Certification Mark.

1100V , 4x120 SQ.MM LT UG CABLE.

1.	Requirements	1100V rated 4 x 120 sq.mm LT UG cable, comprising of Multi-stranded shaped compacted Aluminium Conductor of grade H2/H4, XLPE insulated,cores laid up, inner sheath of extruded PVC of type ST2, galvanized steel strips armoured and PVC of type ST2 sheathed overall, conforming to IS.7098/Part-1/1988 with its amendments upto date and with ISI marking.
2.	Voltage	1100 Volts
3.	Purpose	For use in L.T. distribution network, cable to be laid in trench/ directly underground.
4.	Conductor size	4 x 120 sq.mm., 4 x240 Sq.mm.
5.	Conductor materials	Aluminium of H2/H4 grade complying with ISS 8130/1984, with latest amendments, if any
6.	Formation of conductor	Multistranded shaped compacted conductor
7.	No. of wires in conductor	4x120 sq.mm For the main core - 37

ANNEXURE- II

TECHNICAL QUALIFYING REQUIREMENTS:-

I. **Applicable for PVC Cable:**

The manufacturers, whose PVC cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 100 kM of 1.1 kV grade PVC insulated control cables to Electricity boards/ Power Utilities in India during the last 10 years as on the date of Technical bid opening (21/08/2017). Further, the manufacturer should also have designed, manufactured, tested and supplied at least 1 kM of 27C x 2.5 sq.mm or higher size to Electricity boards/ Power Utilities in India during the last 10 years as on the date of Technical bid opening 21/08/2017.

II. **Applicable for XLPE Cable:**

The Manufacturer, whose XLPE Power cables are offered, should have designed, manufactured, tested and supplied in a single contract at least 25 kM of 1.1 kV or higher grade XLPE insulated power cables to Electricity boards/ Power Utilities in India during the last 10 years as on the date of technical bid opening (21/08/2017). Further the manufacturer should also have designed, manufactured, tested and supplied at least 1 kM of 300 sq. mm or higher size to Electricity boards/ Power Utilities in India during the last 10 years as on the date of technical bid opening 21/08/2017.

SECTION-2

A. EQUIPMENT SPECIFICATION FOR 1.1KV AUX POWER AND CONTROL CABLES

2.0 SCOPE

This technical specification covers the requirement of design, manufacture, testing, packing and dispatch of 1.1 kV grade Auxiliary power and control cables (FRLS type). No deviation from the requirements specified in various clauses of this specification shall be allowed.

2.1 APPLICABLE STANDARDS

The auxiliary power and control cables shall conform to following latest Indian and International standards and their amendments.

IS 1554	PVC insulated (heavy duty) electric cables -
(Part I)	For working voltage up to and including 1100V
IS 7098	XLPE insulated PVC sheathed cables -
(Part I)	For working voltage up to and including 1100V
IS 5831	PVC insulation and sheath of electric cables.
IS 8130	Conductors for insulated electric cables and flexible cords.
IS 3975	Low Carbon Galvanized Steel Wires, Formed Wires and Tapes for Armouring of Cables - Specification
IS 10810	Method of tests for cables.
IEEE-383	Standard for type test of class IE electric cables, field splices, and connections for nuclear power generating stations.
ASTM-D2843	Standard test method for density of smoke from burning or decomposition of plastics.
ASTM-D2863	Standard test method for measuring minimum oxygen concentration to support candle - like combustion of plastics (oxygen index).
IEC: 60754 (Part-1 & 2)	Test on gases evolved during combustion of electric cables -
IEC: 60332 (Part I to 3)	Tests on electric and optical fibre cables under fire conditions
IS 3961 (Part II)	Recommended current rating for cables - PVC insulated and PVC sheathed heavy-duty cables.
IS 10418	Drums for electric cables.
SS 4241475	Swedish chimney test

2.2 CONSTRUCTIONAL FEATURES

i) Cables shall be suitable for laying in racks, ducts, trenches, conduits and underground-buried installation with uncontrolled back fill and chances of flooding by water. They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.

ii) The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects.

iii) A distinct extruded inner sheath shall be provided in all armoured cable. The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, softer than insulation & suitable for the operating temperature of the cable & compatible with the insulating material. The outer sheath shall be suitable for the operating temp. of the cable. ~~For single core cable, inner sheath may not be provided.~~

iv) Progressive sequential marking of the length of cable in meters at every one-meter shall be provided on the outer sheath of all cables.

v) All power & control cables shall have an extruded outer sheath of PVC having following flame retardant & low smoke evolution properties.

Oxygen index - Minimum 29 (to ASTMD 2863).

Acid gas emission - Maximum 20% by weight (to IEC 754 – I).

Smoke density rating – Maximum 60% (to ASTMD 2843).

vi) All cables shall be suitable for high ambient high humid tropical Indian climatic conditions.

vii) The normal current rating of all PVC insulated cables shall be as per IS 3961.

viii) All cables shall conform to type test and shall be subjected to routine and acceptance tests listed in the specification.

ix) Allowable tolerance on the overall diameter of the cables shall be ± 2mm.

x) The minimum bending radius for the cables shall be equal to 12*D, where D is the overall diameter of the cable for multicore cables and 15*D for single core cable.

xi) Suitable chemicals shall be added to the outer sheath of all cables to protect from rodent, vermin and termite attack.

xii) Repaired cables shall not be acceptable.

xiii) Cores shall be identified as per IS 1554 (Part-I)/ IS 7098 Part-I for the cables upto five (5) cores and for cables with more than five (5) cores the identification of cores shall be done by printing legible Hindu Arabic numerals on all cores as per Clause 10.3 of IS 1554 (Part-1).

xiv) Manufacturer's name, type of cable, number of cores, year of manufacture and sequential marking of length in metres at every one metre shall be permanently marked on the outer sheath throughout the entire length of cable.

2.3 CURRENT RATING FOR CONTROL and AUX. POWER CABLES

2.3.1 Normal current rating shall not be less than that covered by IS 3961. Vendor shall submit data in respect of all cables in the prescribed format.

2.3.2 PVC insulated cables shall be suitable for continuous conductor temperature of ~~70/~~ 85 °C and short circuit withstand temperature of 160 °C. Tables giving de-rating factors for various conditions of cable installation including the following, for all types of cables shall be furnished -

- Variation in ambient air temperature.
- Variation in ground temperature.
- Depth of laying.
- Cables laid in the ground
- Cables laid in trench
- Cables laid in ducts
- Soil resistivity.
- Grouping of cables.

Overall derating factor for cable shall be 0.8 or less.

2.3.3 The value of short circuit withstand current ratings of all cables shall be indicated for a short circuit for 1 second duration and should also specify the maximum temperature during short circuit.

2.3.4 The following factors shall also be accounted for, while specifying the maximum short circuit withstand of the cables.

2.3.4.1 Deformation of the insulation, due to thermo-mechanical forces produced by the short circuit conditions, can reduce the effective thickness of insulation.

2.3.4.2 Conductor and core screens can be adversely affected with loss of screening effect. Likewise the thermal properties of the outer sheath material can be the limitation.

2.3.4.3 It is essential that the accessories, which are used in the cable system with mechanical and/or soldered connections, are suitable for the temperature adopted for the cables.

2.3.5 Formula for calculating short circuit current for different duration or curve showing short time current v/s time for different sizes of cables shall be furnished by vendor.

2.4 CABLE DRUMS

2.4.1 Cables shall be supplied in non-returnable wooden cable drum or steel drum of heavy construction. It shall be made of good quality wood, pressure impregnated against fungal and insect attack. Wood preservative shall be applied to the entire drum. The ends of the each length of cable shall be sealed before dispatch.

2.4.2 All Control and Power Cables shall be supplied in drum length of ~~1000/~~ 500 m, unless otherwise specified. ~~For power cable with conductor cross sectional area 300sqmm and above may be~~

~~supplied in 500m drums.~~ Each drum shall contain one continuous length of cable. Owner shall have the option of rejecting cable drums with shorter lengths. The cable length per drum is allowed a tolerance of ±5%. The tolerance allowed on total quantity of each size is ±2%. Where the ordered quantity is not multiple of 1000/500 m and the incremental quantity is very small, the same may be included in one of the drums. Otherwise, an additional length for the incremental quantity will be supplied.

2.4.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

2.4.4 A clear space of at least 40mm shall be left between the cables and the logging.

2.4.5 Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of the cable, net and gross weight stenciled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wordings shall be marked on one end of the reel indicating the direction in which it should be rolled.

2.4.6 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

2.5 TESTS

All types and sizes of cables shall be subjected to following routine and acceptance tests and type tests.

2.5.1 Type and Acceptance test

The following test shall be performed on one length from each manufacturing series of same type and size of cable, covering at least 10% of all cable drums / test reports shall be submitted as per Section-5. The type and acceptance tests shall be witnessed by purchaser / purchaser's representatives.

a) Annealing test (for Copper conductor), Tensile & Wrapping Tests (for Aluminium for conductor) as per IS 8130.

b) Conductor resistance test as per IS 8130.

c) Test for armouring wires/ formed wire (% Elongation, Tensile, Torsion/ winding, Resistance, Wt of Zinc coating, Dimension and uniformity of coating) as per IS 1554 (Part-I), IS 7098 (Part-I), IS 3975.

d) Check for dimensions of insulation, sheath and conductor as per IS 1554 (Part-I), IS 7098 (Part-I).

e) Physical tests for insulation and sheath as per IS 1554 (Part-I), IS 7098 (Part-I), IS 5831 as applicable.

f) Insulation resistance test as per IS 1554 (Part-I), IS 7098 (Part-I), IS 5831 as applicable.

g) High voltage test at room temperature as per IS 1554 (Part I), IS 7098 (Part-I) as applicable.

h) High voltage test (water immersion test) as per clause 16.3 of IS 1554 (Part I).

i) Flammability test as per clause 2.5 IEEE-383 / IEC 60332 part 3.

j) Smoke density rating test as per ASTM-D2843.

k) Oxygen index and Temperature index test as per ASTM-D2863.

l) Acid gas generation test as per IEC: 60754

m) Flammability test as per IS 1554 Part-I/ IS 7098 Part-1.

n) Swedish chimney test F3 category as per SS 4241475

~~Following special type tests shall be performed on one sample from each lot of the offered cables:~~

~~a) Hydraulic Stability Test~~

~~b) Ultraviolet Test as per DIN 53387~~

The above list is indicative only. All type and acceptance tests as per relevant IS and as per customer approved MQP shall be carried out on the offered cables. The prices for conducting all tests are deemed to be included in respective cable prices.

2.5.2 Routine tests

The following routine tests shall be conducted on full length of the cable. These shall be witnessed by purchaser / purchaser's representatives.

a) High voltage test as per clause 16.2 of IS 1554 (Part I).

b) Conductor resistance test as per clause 6.3 of IS 8130.

SECTION – 3

PROEJCT DETAILS & GENERAL TECHNICAL REQUIREMENT

3.0 FOREWORD

The provisions under this section are intended to supplement general requirements for the materials, equipment's and services covered under other sections.

3.1 PROJECT INFORMATION AND SYSTEM PARAMETERS

a) Customer : M/s Tamil Nadu Transmission Corporation Limited

b) Project Title : 400/230-110 kV Substation at Vellalaviduthi

c) Transport facilities : Road/Rail

Physical and other parameters:

3.1.1 Location of the substation : Vellala viduthi, Pudukottai district

3.1.2 Nearest Railway station : Pudukottai
Railway : Southern Railway

3.1.3 Meteorological data

(i) Maximum ambient temperature	: 50°C
(ii) Minimum ambient temperature	: 20°C
(iii) Maximum daily average ambient air temperature	: 45° C
(iv) Maximum yearly average ambient air temperature	: 32° C
(v) Maximum Humidity (%)	: 100%
(vi) Average thunder storm days per annum	: 50
(vii) Average rainy days per annum	: 90
(viii) Average annual rainfall (mm)	: 1000 mm
(ix) No. of months during which tropical monsoon condition prevail	: 5
(x) Maximum wind pressure	: 150 Kgf/Sqmm
(xi) Altitude above MSL	: 1000M

However for design purpose, ambient temperature should be considered as 50° C and relative humidity as 100%.

MAIN ELECTRICAL PARAMETRS:		
a)	Fault Levels	400kV: 63kA for 1 sec. 230kV: 40kA for 3 sec. 110kV: 40kA for 3 sec.
a)	Creepage Distance	25mm/kV

3.1.4 AUXILIARY POWER SUPPLY :

Auxiliary electrical equipment's, maintenance equipment's etc., shall be suitable for operation on the following supply system.

3 phase AC Supply	415V, 3 phase 4 wire, 50 Hz, neutral grounded AC supply -10% to +10%, Frequency +/- 5%
1 phase AC supply	240V, single phase, 50 Hz, neutral grounded AC supply -10% to +10%, Frequency +/- 5%,
DC supply	220V, 2 wire DC supply + 10% to –15%, Ungrounded 48V, 2 wire DC supply , Positively earthed

3.2 GENERAL REQUIREMENT

3.2.0 ALL THE EQUIPMENTS / MATERIALS TO BE SUPPLIED SHOULD BE IN ACCORDANCE WITH RELEVANT LATEST / AMENDED IS/IEC, WHETHER IT HAS BEEN SPECIFICALLY MENTIONED IN THE SPECIFICATION OR NOT.

3.0.1 The bidder shall also furnish drawings for the following:

All EQUIPMENTS and type of clamps, fittings hardwares, insulators, bus bar. These designs/ drawing shall be got approved by the purchaser before commencing the manufacture/ construction/ erection and are to be as per latest IS/ IEC.

3.2.2 GENERAL:

The bidder shall be fully responsible for providing all equipment, materials system and services specified or otherwise which are required to complete the construction and successful commissioning of the substation in all respects.

Any other items not specifically mentioned in the specification but which are required for erection of materials/equipment under the scope of work, testing and commissioning are deemed to be included in the scope of the specification unless specifically excluded.

All items shall be supplied as per schedule and as specified in the relevant Indian standard of latest revision. The Technical specification of the main materials/equipment is furnished. The Technical specification contained herein for the materials are for the guidance of the tenderer.

The bidders are requested to procure the equipment's/materials/component only from reputed /qualified manufacturer as per Technical requirement stipulated in Section-1 of Technical specifications. Approval of make of item shall be taken up by vendor from TANTRANSCO himself.

3.3 SPECIFIC REQUIREMENT

The bidder shall furnish make/manufacturer, catalogues, engineering data, technical information, design documents, drawings etc., fully in conformity with the technical specification and get approval from competent authority before commencement of any work.

All steel materials, other than materials for earthing should be of galvanized if not specified.

3.4 STANDARD:

The works covered by the specification shall be designed, engineered, manufactured, built, tested and commissioned in accordance with the Acts, Rules, Laws and Regulations of India.

The equipment to be furnished under this specification shall conform to latest issue with all amendments (as on the date of bid opening) of standards specified in the specification.

The Bidder shall note that standards mentioned in the specification are not mutually exclusive or complete in themselves, but intended to complement each other.

The Bidder shall also note that list of standards presented in this specification is not complete. Whenever necessary the list of standards shall be considered in conjunction with specific IS/IEC.

When the specific requirements stipulated in the specifications exceed or differ than those required by the applicable standards, the stipulation of the specification shall take precedence.

3.5 TEST CERTIFICATE:

Copies of all test certificates relating to material to be procured by the contractor for the works shall be forwarded to the OWNER.

3.6 TESTS :

All the tests as per relavant IS/IEC shall be carried out.

3.7 MATERIALS AND WORKMANSHIP:

All the materials shall be of the best class and capable of satisfactory operation in the tropics with humid atmosphere conditions. Unless otherwise specified, they shall conform to the requirements of the appropriate IS/IEC.

The workmanship shall be of the best grade and the entire construction in accordance with the best modern practice.

The equipment shall be designed to facilitate inspection and repairs and to ensure satisfactory operation under atmosphere condition prevailing at site and under such sudden variation of load and voltage as may be met with under working conditions in the system including those due to faulty synchronizing and short circuit within the rating of the apparatus.

The design shall incorporate every reasonable precaution and provision for the safety of all those concerned in the operation and maintenance of the equipment.

All the equipments should operate without undue vibration and with the least practicable amount

of noise.

3.8 INSPECTION :

The inspection may be carried out by the TANTRANSCO/BHEL at any stage of manufacture. The supplier shall grant free access to TANTRANSCO's/BHEL representative at a reasonable time when the work is in progress. The TANTRANSCO/BHEL shall have access at all times to the works and all other places of manufacture/fabrication, where the equipments are being manufactured/fabricated and the bidder shall provide TANTRANSCO's/ BHEL representative all facilities for unrestricted inspection of the works, raw materials, manufacture of all the accessories and for conducting necessary tests.

Inspection and acceptance of any equipment under this specification by the TANTRANSCO/BHEL shall not relieve the supplier of his obligation of furnishing equipment in accordance with the specification and shall not prevent subsequent rejection if the equipment is found to be defective. The supplier shall keep the TANTRANSCO/BHEL informed in advance, about the manufacturing programme so that arrangement can be made for inspection.

The TANTRANSCO/BHEL , reserves the right to insist for witnessing the acceptance/routine testing of the bought out items. No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

The correct grade and quality of steel shall be used by the supplier. To ascertain quality of steel, the TANTRANSCO/BHEL may at his discretion get the material tested at an approved laboratory.

The bidder shall take an account the fabrication wastage while quoting the rates. The Employer will not accept any liability in connection with the wastage of steel during fabrication or otherwise. Steel shall be procured exclusively from the main producers. However, sections not rolled by main produces can be procured from reroller, provided rerolling of structural steel section is done from billets/ingots of tested quality. Rerolled sections are duly tested as per relevant standards. Supplier should obtain approval of list of primary producers of Steel and Zinc before Proto assembly.

The BHEL/TANTRANSCO or his representative shall have the right to inspect and/or test the goods /works to confirm their conformity to the supplier. BHEL/TANTRANSCO shall notify the supplier in writing of the identity of any representatives authorized for these purposes.

The inspections and tests may be conducted on the premises of the supplier or his Sub vendor at the point of delivery and /or at the goods' final destination. Where tests are conducted in the premises of Supplier, all reasonable facility and assistance including access to drawings and production data shall be furnished at no charge to the BHEL.

Should any inspected or tested goods fail to conform to specifications, the BHEL/TANTRANSCO may reject them and the supplier shall either replace the rejected goods or make all alterations necessary to meet specification requirements free of cost to the BHEL/TANTRANSCO within one week of intimation.

The BHEL/TANTRANSCO's right to inspect, test and where necessary reject the goods after the goods; arrival at the site, shall in no way be limited or waived by reason of the goods having been previously inspected. Tested and passed by the BHEL/TANTRANSCO or his representative prior to the goods dispatch.

Not less than 15 (Fifteen) days advance intimation shall be given about the quantity of materials that will be ready for inspection by the officers of TANTRANSCO/ BHEL/Third agency authorized by the Corporation. The materials should not be dispatched without instruction from the Corporation.

3.9 GUARANTEE:

The supplier shall guarantee that the goods under the Contract are new, unused of the most recent or current models and incorporated all recent improvements in design and materials unless provided otherwise in the Contract. The supplier shall further guarantee that the goods supplied under this Contract shall have no defects arising from design, materials or workmanship, installation and erection, if that may develop under normal use of the supplied goods. The supplier shall also guarantee the performance of the works executed by him including the performance of all the materials/goods supplied by him.

BHEL shall promptly notify supplier in writing of any claims arising under guarantee in respect of goods. Upon receipt of such notice, the supplier shall, with all reasonable speed, repair or replace the defective works or parts thereof, free of cost at site. All the expenses towards transportation of defective parts to supplier's works and of repaired/replaced parts to site shall be borne by the Supplier.

If the Supplier, having been notified, fails to remedy the defects within 14 days, the BHEL will proceed to take such remedial action as may be necessary, at the supplier's risk and expenses. All expenses in this regard will be recovered from Supplier.

3.10 PRE COMMISSIONING TESTING (if applicable) :

On completion of erection of equipment's and before charging each item of equipment's shall be thoroughly cleaned and inspected jointly by the TANTRANSCO/ BHEL and the bidder for correctness and completeness of installation and acceptability for charging leading to initial pre commissioning test. The pre commissioning testing to be carried all equipment's in the presence of BHEL/ TANTRANSCO. Necessary tools, testing kits to be arranged by the Supplier.

3.11 DOCUMENTATION :

All drawings shall conform to relevant international standards Organization (ISO) specification. All drawings shall be in ink and suitable for micro filming. All dimensions and data shall be in S.I. units.

3.12 PAINTING, GALVANISING :

All interiors and exteriors of all metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter and the surfaces treated by phosphating (e.g. seven tank phosphating sequences).

All metal surfaces exposed to atmosphere shall be given, in addition to the treatment, two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limits specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling. All external paintings shall be as per shade **No.697/631 of IS-5**.

Paint inside the metallic housing shall be of anti condensation type and the paint on outside surfaces shall be suitable for outdoor installation.

All components shall be given adequate treatment of climate proofing as per **IS: 3202** so as to withstand corrosive and several service conditions.

All ferrous parts including all sizes of nuts, bolts, support channel structures, etc. as also the mechanism housing shall be hot dip galvanized conforming to latest version of IS : 2629 or epoxy painted. Spring washers shall be electro-galvanised.

All members of the structure members shall be hot dipped galvanised with a zinc coating of **610 gms. per square metre** . Galvanising shall be done after a work is completed, except that the nuts may be tapped or rerun after galvanization. The zinc coating shall be smooth, clean, of uniform thickness and free from defects. The preparation for galvanising itself shall not adversely affect the mechanical properties of the coated materials. The employer shall be at liberty to have the samples of zinc used, test checked in any laboratory at his own cost and reject the particular supply if it is below standard.

All galvanised material shall withstand test as per IS 2633-1972 or any other equivalent standard. The zinc used for galvanising fabricated material shall be of high grade Electrolytic zinc of 99.99% purity.

All nuts and pins shall be adequately locked. Nuts, bolts and pins used inside the transformer and tap-changer compartment where gaskets are not used shall be provided with spring washers or locknuts. Where galvanizing is specified, it shall be applied by the hot dipped process or by electro-galvanizing process and for all parts, other than steel wires, shall consist of a thickness of zinc coating equivalent to not less than 610gm of zinc per square meter of surface. The zinc coating shall be smooth, of uniform thickness and free from defects.

3.13 SURFACE FINISH

All interiors and exteriors of tanks, control cubicles and other metal parts shall be thoroughly cleaned to remove all rust, scales, corrosion, greases or other adhering foreign matter. All steel surfaces in contact with insulating oil as far as accessible, shall be painted with not less than two coats of heat resistant, oil insoluble, insulating paints.

All metal surfaces exposed to atmosphere shall be given two primer coats of zinc chromate and two coats of epoxy paint with epoxy base thinner. All metal parts not accessible for painting shall be made of corrosion resisting material. All machine finished or bright surfaces shall be coated with a

suitable preventive compound and suitably wrapped or otherwise protected. All paints shall be carefully selected to withstand tropical heat and extremes of weather within the limit specified. The paint shall not scale off or wrinkle or be removed by abrasion due to normal handling.

3.14 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves, pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.15 FUNGI-STATIC VARNISH

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on the parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interface with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application to the varnish.

3.16 DEGREE OF PROTECTION

The supplier shall propose following Degree of protection for those equipment/Items for which the degree of protection has not been specified in the specification for the approval of BHEL/ TANTRANSCO. The decision of BHEL/TANTRANSCO shall be final. The enclosures of the Control Cabinets, Junction boxes and Marshalling boxes, panels etc to be installed shall provide degree of protection as detailed here under:

a) Installed outdoor: IP-55
b) Installed indoor in air conditioned area: IP-42
c) Installed in covered area IP:52
d) For LT switchgear (AC & DC distribution Boards): IP-54

The degree of protection shall be in accordance with IS: 13947 (Part-1)/ IEC-60947 (Part-1)/ IS 12063 / IEC-60529. Type test report for degree of protection test on each type of the box shall be submitted for approval.

3.17 FIRST FILL OF CONSUMABLES, OIL AND LUBRICANTS

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, soldering/brazing material for all copper piping of circuit breakers and essential chemicals etc. which will be required to put the equipment covered under the scope of the specifications, into operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these

specifications and documents.

3.18 RATING PLATES, NAME PLATES AND LABELS :-

The equipments shall be provided with a rating plate or plates marked with but not limited to following data whatever needs to that particular equipments (as applicable).

(a) Manufacturer's name or trade mark.
(b) Serial number and type design making it possible to get all relevant information from the manufacturer.
(c) Year of manufacture.
(d) Rated voltage
(e) Rated insulation level.
(f) Rated frequency
(g) Rated Normal current.
(h) Rated short circuit breaking current
(i) First pole to clear factor
(j) Rated duration of short circuit
(k) Rated auxiliary D.C. supply voltage of closing and opening devices.
(l) Rated pressure of SF6 gas for operation and interruption.
(m) Rated out of phase breaking current.
(n) Rated supply voltage of auxiliary circuit.
(o) Rated supply frequency of auxiliary circuits.
(p) Purchase Order Number and Date.

The rating plate shall be visible in position of normal service and installation. The rating plate shall be weather proof and corrosion proof.

Each main and auxiliary item of substation is to have permanently attached to it in a conspicuous position a rating plate of non-corrosive material upon which is to be engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions under which the item of substation in question has been designed to operate, and such diagram plates as may be required by the BHEL/TANTRANSCO. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates of transformers, reactors, CB, CT, CVT, SA, Isolators, C & R panels and PLCC equipments shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided. During approvals drawings of Rating/name plates/labels shall also be submitted.

3.19 TERMINAL CONNECTORS :

The terminal connectors shall meet the following requirements.

a. Terminal connectors shall be manufactured and tested as per IS : 5561.
b. All castings shall be free from blow holes, surface blisters, cracks and cavities.
c. All sharp edges and corners shall be blurred and rounded off.

d. No part of a clamp shall be less than 10mm thick.
e. All ferrous parts shall be hot dip galvanized conforming to IS: 2633.
f. For bimetallic connectors, copper alloy liner of minimum thickness of 2mm shall be cast integral with Aluminium body. Flexible connectors shall be made from tinned copper.
g. All current carrying parts shall be designed and manufactured to have a minimum contact resistance.
h. Connectors shall be designed to be corona free in accordance with the requirements stipulated in IS : 5561.
i. Terminal connectors shall be for Twin Moose Conductor with a spacing of 450mm between the conductor.

3.20 EARTHING :

The operating mechanism housing, control cabinets, support structure etc. shall be provided with two separate earthing terminals suitable for bolted connection to 50x8mm mild steel flat to be provided for connection to station earth mat.

Circuit breakers, LA, Isolator, CVT, CT, BPI shall be provided with two grounding pads suitable for connection to galvanized steel flat of Size 75x12 mm. Control panels, Relay panel, outdoor marshalling boxes, Junction boxes, Lighting panels and distribution board shall be provided with two grounding pads, for connection to galvanized steel flat. The two pads shall be provided, one each at the middle of the two opposite sides of the bottom frame of the equipment. Earthing of hinged door shall be done by using a separate earth wire.

3.21 TERMINAL BLOCKS AND WIRING

Control and instrument leads from the switchboards or from other equipment will be brought to terminal boxes or control cabinets in conduits. All Inter-phase and external connections to equipment or to control cubicles will be made through terminal blocks.

Terminal blocks shall be 1100 V grade and have continuous rating to carry the maximum expected current on the terminals. Those shall be of moulded piece complete with insulated barriers stud type terminals, washers, nuts and lock nuts. Screw clamp, overall insulated, insertion type, rail mounted terminals can be used in place of stud type terminals. But preferably the terminal blocks shall be non-disconnecting stud type equivalent to Elmex type CATM4, Phoenix cage clamp type of Wedge or equivalent. The Insulating material of terminal block shall be nylon 6.6 which shall be free of halogens, fluorocarbons etc.

Terminal block for current transformer and voltage transformer secondary leads shall be provided with test links and isolating facilities. The current transformer secondary leads shall also be provided with short circuiting and earthing facilities.
The terminal shall be that maximum contact area is achieved when a cable is terminated. The terminal shall have a locking characteristic to prevent cable from escaping from the terminal clamp unless it is done intentionally. The conducting part in contact with cable shall preferably be tinned or silver plated however Nickel plated copper or zinc plated steel shall also be acceptable. The terminal blocks shall be of extensible design. The terminal blocks shall have locking arrangement to prevent its escape from the mounting rails.

The terminal blocks shall be fully enclosed with removable covers of transparent, non-deteriorating type plastic material. Insulating barriers shall be provided between the terminal blocks. These barriers shall not hinder the operator from carrying out the wiring without removing the barriers. Unless otherwise specified terminal blocks shall be suitable for connecting the following conductors on each side.

All circuits except CT circuits :	Minimum of 2 nos. of 2.5 sq.mm.copper flexible.
All CT circuits :	Minimum of 4 nos. of 2.5 sq.mm, copper flexible.

The arrangements shall be in such a manner so that it is possible to safely connect or disconnect terminals on live circuits and replace fuse links when the cabinet is live. At least 20 % spare terminals shall be provided on each panel/cubicle/box and these spare terminals shall be uniformly distributed on all terminals rows.

There shall be a minimum clearance of 250mm between the first bottom row of terminal block and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum of 150 mm. The Supplier shall furnish all wire, conduits and terminals for the necessary inter-phase electrical connection (where applicable) as well as between phases and common terminal boxes or control cabinets.

All input and output terminals of each control cubicle shall be tested for surge withstand capability in accordance with the relevant IEC Publications, in both longitudinal and transverse modes. The supplier shall also provide all necessary filtering, surge protection, interface relays and any other measures necessary to achieve an impulse withstand level at the cable interfaces of the equipment.

TB sizes for incoming power supply shall be informed/confirmed during drawing approval stage.

3.22 CONTROL CABINETS, JUNCTION BOXES, TERMINALS BOXES AND MARSHALLING BOXES FOR OUTDOOR EQUIPMENTS

All types of boxes, cabinets etc. shall generally conform to and be tested in accordance with IS-5039, IS-8623 or IEC-439, as applicable and the clause given below.

Control cabinet, Junction boxes, Marshalling boxes & Terminal boxes shall be made of sheet steel. Sheet steel used shall be at least 2.0 mm thick cold rolled or 2.5 mm hot rolled. The box shall be properly braced to prevent wobbling. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation. Cabinet/boxes shall be free standing floor mounting type, wall mounting type or pedestal mounting type as per requirements.

Cabinet /boxes shall be provided with double hinged doors with padlocking arrangements. The distance between two hinges shall be adequate to ensure uniform sealing pressure against atmosphere. The quality of gaskets shall be such that it does not get damaged/cracked during the operation of the equipment.

All door, removable covers and plates shall be gasketed all around with suitably profiled Neoprene /EPDM gaskets. The gasket shall be tested in accordance with approved quality plan. The quality of gasket shall be such that it does not get damaged /cracked during the years of the equipment or its major overhaul whichever is earlier. All gasketed surfaces shall be smooth, straight and reinforced if necessary to minimize distortion and to make a tight seal. Ventilating Louvers, if provided, shall have screen and filters. The screen shall be fine wire mesh made of brass.

All boxes/cabinets shall be designed for the entry of cables from bottom by means of weather proof

and dust-proof connections. Boxes and cabinets shall be designed with generous clearances to avoid interference between the wiring entering from below and any terminal blocks or accessories mounted within the box or cabinet. Suitable cable gland plate projecting at least 150 mm above from the base of the Marshalling Kiosk/box shall be provided for this purpose along with the proper blanking plates. Necessary number of cable glands shall be supplied and fitted on this gland. The gland shall project at least 25mm above gland plate to prevent entry of moisture in cable crutch. Gland plate shall have provision for some future glands to be provided later, if required.

3.23 SPACE HEATERS

The heater shall be suitable for continuous operation at 240 V AC supply voltage and shall be provided with on – off switch and fuse shall be provided for heater.
One or more adequately rated, thermostatically connected heaters shall be supplied to prevent condensation in any compartment.

3.24 DELIVERY OF GOODS AND DOCUMENTS RELATED THERETO:

Delivery of goods shall be made by the supplier in accordance with the terms specified by the BHEL in its schedule of requirements.

3.25 INCIDENTAL SERVICES:

The Supplier is required to provide any or all the services broadly outlined in the Technical specification. Any other minor incidental service related to the scope of work like providing necessary assistance whether specifically mentioned or not must be carried out by the Supplier at his own cost. All tools, Tackles Plant etc., required for completion of above works shall be brought by the Supplier.

3.26 DISCREPANCIES BETWEEN DRAWING AND SPECIFICATION:

Should there be any discrepancy between the specifications and/or schedule of prices and/or drawings or any inconsistency, error or omission in either of them, reference must be made to the BHEL/TANTRANSCO for an explanation and the Supplier will be held responsible for any errors that may occur in the work through neglect of this precaution. The explanation of the BHEL/TANTRANSCO shall be final and binding on the Supplier.

3.27 LIST OF DRAWINGS AND DOCUMENTS :

The drawings for the equipments provided by the TANTRANSCO/BHEL shall be followed strictly by the bidder while designing. For the rest of the equipments, the design is in the scope of the bidder and the same got approved by the TANTRANSCO/BHEL.

The bidder shall furnish one set of relevant descriptive and illustrative published literature pamphlets and the following drawings/documents for preliminary study along with the Offer (as applicable). (Drawings, GTP, type test reports, list of past supplies etc. Drawings & documents submitted at the time of offer shall be subject to review at contract stage)

(i) General outline drawings showing dimensions and shipping weights, quantity of insulating media, etc.
(ii) Sectional views showing the general constructional features of the equipment (eg. Breaker drg includes operating mechanism, arcing chambers, contacts with lifting dimensions for maintenance).
(iii) Schematic diagrams of equipment (eg. Breaker drg includes for control supervision and re-closing.)
(iv) Structural drawing, design calculations and loading data for support structures.
(v) Foundation drilling plan and loading data for foundation design.
(vi) The Type Test Reports
(vii) Bill of materials shall be furnished along with drawings.

The supplier shall, within 1 week of placement of order submit six sets of final version of all the above drawings for TANTRANSCO/BHEL approval. The TANTRANSCO/BHEL shall communicate its comments/approval on the drawings to the supplier within reasonable period. The Supplier shall, if necessary, modify the drawings and resubmit six copies of the modified drawings for TANTRANSCO/ BHEL approval within one week from the date of comments. After receipt of TANTRANSCO/BHEL approval, the supplier shall, within two weeks, submit 8 prints and two good quality reproducible of the approved drawings for TANTRANSCO/BHEL use. However the drawing approval does not absolve the supplier from complying with the terms of the specification.

The following should be supplied to each consignee circle along with the initial supply of equipments ordered.

1) Five copies of printed and bound volumes of operation, maintenance and erection manual in English along with the copies of approved drawings and type test reports etc.
2) Three sets of manuals detailed in item (1) shall be supplied to the TANTRANSCO/BHEL within one week from the date of approval of drawings.
3) The spares for the Equipment's ordered under the scope of the Contract should also be supplied to the consignee circle along with initial supply of the equipments.
4) It should be noted that if the above conditions are not fulfilled the initial payment will not be released.

Note: The supplier may please note that all resubmissions must incorporate, all comments given in the submission by the TANTRANSCO/BHEL failing which the submission of documents is likely to be returned. Every revision shall have a revision number, date and subject, in a revision block provided in the drawing, clearly marking the changes incorporated.

Following Documentation schedule to be followed

S. No.	DESCRIPTION	TENDER STAGE	CONTRACT STAGE FOR APPROVAL	FINAL DOCUMENTATION	
			Prints	Prints	CDs
1	Drawings and Data Sheets	1	6	10	5
2	Drawings "As Built "	-	-	10	
3	Type Test Reports	1	6	10	

4	Erection Manuals	-	6	10	
5	Operation and Maintenance Manuals	-	6	10	
6	Manufacturing Quality Plan	-	6	10	
7	Field Quality Plan	-	6	10	
8	Inspection Test Reports	-	6	10	

Note: Drawings will also be submitted in CD/DVD in Latest AUTOCAD-2004 or Later version or any other CAD package along with conversion files for all major items. Final Documentation shall be submitted in bound volumes with details of Customer & Project etc. written on top.

3.28 QUALITY ASSURANCE PLAN :

The bidder shall invariably furnish following information along with his offer.

(i) Statement giving list of important raw materials including but not limited to:
  (a) Contact material
  (b) Insulation
  (c) Porcelain
  (d) Sealing material
  (e) Contactor, limit switches, etc. in control cabinet.

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

(ii) Information and copies of test certificates as in (i) above in respect of bought out accessories.
(iii) List of areas in manufacturing process, where such inspections are normally carried out for quality control and details of such tests and inspections.
(iv) Special features provided in the equipment to make it maintenance free.
(v) List of testing equipment available with the Bidder for final testing of equipments vis-à-vis, the type, special, acceptance and routine tests specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule i.e. schedule of deviations from specified test requirements.

The supplier shall submit following information to the TANTRANSCO/BHEL.

1) List of raw materials as well bought out accessories and the names of sub-suppliers selected from those furnished along with offer.
2) Type test certificates of the raw material and bought out accessories.
3) Quality assurance plan (QAP) withhold points for TANTRANSCO/BHEL inspection. The quality assurance plan and hold points shall be discussed between the TANTRANSCO/BHEL and supplier before the QAP is finalized.

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

3.29 TEMPERATURE RISE :

The maximum temperature attained by any part of the equipment when in service at site under continuous full load conditions and exposed to the direct rays of the sun shall not exceed 30(/25) deg. C over an ambient of 45(/50) deg. C limits specified in relevant IEC. When the standard specify the limit of temperature rise these shall be exceeded when corrected for the difference between ambient temperature at site and that specified in the approved specifications.

No material shall be dispatched from its point of manufacture unless the material has been satisfactorily inspected and tested.

3.30 FITTINGS AND ACCESSORIES :

Following is a partial list of some of the major fittings and accessories to be furnished by contractor as an integral part of the equipment.

Operation mechanism housing complete with:

(a) Locking arrangement.
(b) Heaters equipped with automatic thermostatic control and control switch.
(c) Cable glands.
(d) Local/Remote change over switch.
(e) Operation Counter.
(f) Terminal Blocks.
(g) Control switches to cut off control power supply.
(h) MCCBs/MCBs are required with permanent identification marks for protection of D.C. circuits and A.C. circuits.
(i) Two earthing terminals.

3.31 PACKING AND FORWARDING:

The equipment shall be packed in crates suitable for vertical/horizontal Transport, as the case may be and suitable to withstand handling transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit due to improper and inadequate packing and handling. The easily damageable material shall be carefully packed and marked with the appropriate caution symbols. Wherever necessary, proper arrangement for lifting, such as lifting hooks etc., shall be provided. Any material found short inside the packing cases shall be supplied by supplier without any extra cost.

The supplier shall provide such packing of the goods as is required to prevent their damage or deterioration during transit to their final destination as indicated in the Contract. The packing shall be sufficient to withstand, without limitation, rough handling during transit to their final destination as indicated in the Contract and exposure to extreme temperatures, salt and precipitation etc., during transport and open storage. Packing case size and weights shall be taken into consideration wherever appropriate, the remoteness of the 'goods' final destination and absence of heavy mechanized handling facilities, at all points in transit.

The packing, marking and documentation within and outside the package shall comply strictly with

such special requirements as shall be expressly provided for in the Contract or in any subsequent instructions issued by BHEL.

3.32 SPECIFICATION FOR NITRYL BUTYL RUBBER

The gaskets are to be used in tanks exposed to Transformer mineral oil/SF6 at about 110° C.

1. Hardness should be Shore A 70 ± 5.
2. Tensile Strength should be min. 10.8N/sq.mm (Minimum)
3. Elongation strength should be 270% (Minimum)

AFTER AGEING

1. Change in weight should not be more than 10% and change in Hardness should not be more than Shore A ± 10 after 7 days aging in transformer oil.

2. There should not be any visible damages after accelerated aging of 24 hours in transformer oil of temperature 110° C.

SECTION – 4

GTP

ARMOURED COPPER CONTROL CABLE & LT Aluminium cable

		Copper control cable	LT Aluminium Cable
01.	Name of the manufacturer		
02.	Country of the manufacturer		
03.	Trade Mark/Brand Name		
04.	Applicable standard		
05.	Voltage grade and type of cable		
06.	Suitable for earthed/unearthed system		
07.	Continuous current carrying capacity (Amps)		
	a) In Air		
	b) In Ground		
08.	Conductor DC resistance at 20 Deg. C per 1000 m (max.) ohms		
09.	Conductor:		
	a) Materials		
	b) Cross sectional Area (sq.mm)		
	c) No. of strands in each core		
	d) Formation of conductor		
10.	Insulation:		
	a) Composition of insulation		
	b) Average thickness of insulation (mm)		
	c) Tolerance on thickness of insulation		
	d) Volume resistivity (min.) At 20 ° C At 90 ° C		
	e) Tensile strength N/sq.mm.		
	f) Elongation at break %		
11.	Methods of core identification		
12.	Inner sheath:		
	a) Materials		
	b) Calculated dia under sheath (mm)		
	c) Thickness of sheath (mm)		
	d) Extruded or wrapped		
	e) Tensile strength (N/sq.mm.)		
	f) Elongation at break %		
13.	Armouring		
	a) Materials		
	b) Calculated dia under armour (mm)		
	c) Nominal thickness of steel strips used(mm)		
	d) Weight of Zinc coating (G/sq.mm)		
	e) Volume resistivity (ohms cm)		
14.	Outer sheath		
	a) Materials		
	b) Calculated dia under outer sheath (mm)		

	c) Thickness of sheath (mm)	
	d) Tolerance of thickness of outer sheath	
	e) Tensile strength (N/sq.mm)	
	f) Elongation at break (%)	
	g) Volume resistivity (ohms cm)	
15.	Overall dia of the cable (mm)	
16.	Conductor temperature corresponding to continuous current (centigrade)	
17.	a) Length of cable on drums (m)	
	b) Standard length of each piece (m)	
18.	Maximum weight and dimensions of drums	
19.	Approximate weight of Cable/Km.	
20.	Whether suitable chemicals added in outer sheathing compound for protection against termite	
21.	Other relevant particulars	

SECTION-5

CHECK LIST FOR INFORMATION TO BE FURNISHED WITH OFFER RETURN THIS CHECKLIST AS PART OF THE OFFER DULY SIGNED

The offer may not be considered if the following information and this Checklist are not enclosed with the Offer.

BHEL ENQUIRY. NO:

BIDDER OFFER REFERENCE:

A)

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is *NO***
1.0	**Applicable Standard**	**Latest IS -1554, 5831, 8130, 7098, 3975, 613, ASTM-D2843, ASTM-D2863, IEC60754, IEC60332, IS3961, IS 10418, SS4241475, NEMA WC-70, IEEE-383**		
2.0	**Type**	**FRLS**		
3.0	**Construction feature for PVC Control cable**			
3.1	Material of Conductor for Control cables	Plain Annealed, High Conductivity, Stranded, untinned Copper (with minimum 7 strands), Grade EC		
3.2	Conductor Insulation for ~~Control and Power~~ cables	Extruded PVC, Type-C		
3.3	Inner sheath	Extruded PVC, Type ST-2		
3.4	Armouring for Control Cables	Galvanised Steel Round wire /Strip for multicore cables complying to clause 1.2.1. and 1.2.2 of Section 1		
3.5	Outer sheath for Control cables	PVC extruded, FRLS, Type ST-2, Category C2		
3.6	Drum Length	1000m		

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is *NO***
4.0	**Construction feature for PVC Power cable** (4C x 25 sqmm)			
4.1	Material of Conductor for PVC Power cables	Stranded Aluminium (with minimum 7 strands), Grade H2 /H4		
4.2	Conductor Insulation for PVC Power cables	Extruded PVC, Type-A		
4.3	Inner sheath	Extruded PVC, Type ST-1		
4.4	Armouring for Power Cables	Galvanised Steel Round wire /formed wire for multicore cables complying to clause 1.2.1. and 1.2.2 of Section 1		
4.5	Outer sheath for Control cables	PVC extruded, FRLS, Type ST-1, Category C2		
4.6	Drum Length	1000m		
5.0	**Construction feature for XLPE Aux Power cable**			
5.1	Material of Conductor for Power cables	Stranded Aluminium (with minimum 7 strands), Grade H2 /H4		
5.2	Conductor Insulation	XLPE		
5.3	Inner sheath	Extruded PVC, Type-ST2		
5.4	Armouring for Aux Power Cables	Galvanised Steel round wire/formed wire for Multi-core cables complying to clause 1.2.1. and 1.2.2 of Section 1		
5.5	Outer sheath	PVC extruded, FRLS, Type ST-2, Category C2		
5.6	Drum Length	500m		
6.0	**FRLS properties of Outer sheath**			
6.1	Minimum Oxygen index	29 at room temp. as per ASTMD 2863		
6.2	Minimum Temperature index	250°C at 21 oxygen index when tested as per ASTMD 2863		
6.3	Acid gas emission	Max 20% by weight as per IEC 754-I		

(1)	(2)	(3)	(4)	(5)
S.No.	**Parameters**	**Data**	**Yes / No**	**Remarks in case reply in Col (4) is *NO***
6.4	Smoke density rating	Max 60% as per ASTMD 2843		
7.0	Tolerance on overall diameter	± 2mm		
8.0	Chemicals added to outer sheath to protect from rodent, vermin and termite attack	Yes		
9.0	Drum lengths shall be 500m for cables with conductor cross section area less than 300 sq mm	Yes		
10.0	Tolerance on total quantity	± 2%		
11.0	Minimum bending radius for multicore cables	12 x D		
12.0	Core Identification	By colour coding as per IS 1554 (Part-I)/ IS 7098 Part-I for the cables upto five (5) cores; and for the cables with more than five (5) cores, by printing legible Hindu Arabic numerals on all cores as per Clause 10.3 of IS 1554 (Part-1).		
13.0	The fillers and inner sheaths shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable	**Yes**		

B) TYPE TESTS

i) All type tests as per relevant IS/IEC **shall be performed on each type and size of cables** as a part of acceptance tests & price for conducting the same are included in the offered price for individual cables. **(YES)**

C)

(1)	(2)	(3)
S.No.	**Description**	**Confirmation of Supplier**
1.	Bidder to confirm that at all drawings / data sheets/QP/ valid type tests reports/ all relevant information shall be submitted to BHEL for organising approval of ultimate customer.	

Date:

Signature of the authorized representative of Bidder

Company Seal