

VOLUME II

**TAMILNADU GENERATION & DISTRIBUTION
CORPORATION LIMITED**

2 X 660MW ENNORE SEZ SUPERCRITICAL TPP

TECHNICAL SPECIFICATION

FOR

LT XLPE POWER CABLES

SPECIFICATION NO: *PE-TS-412-507-E012*

REVISION: 0



BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, UP (INDIA) – 201301



DOCUMENT TITLE

**TECHNICAL SPECIFICATION FOR
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	(INCLUDING COVER/ SEPARATOR SHEETS)	



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COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same
2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in 'BOQ-Cum-Price schedule' of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

BIDDER'S STAMP & SIGNATURE



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SECTION –I

SPECIFIC TECHNICAL REQUIREMENTS



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1.0 SCOPE OF ENQUIRY

- 1.1 Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of LT XLPE POWER CABLES conforming to this specification.
- 1.2 General technical requirements of the LT XLPE Power cables are indicated in Section-II. Project specific technical/ quality requirements / changes are listed in Section-I.
- 1.3 The stipulations of Section-I, followed by those of Data Sheet-A shall prevail in case of any conflict between the stipulations of Section-I, Data Sheet - A & Section-II.
- 1.4 The documents shall be in English Language and MKS system of units.

2.0 BILL OF QUANTITIES:

- 2.1 Quantity requirements shall be as per 'BOQ-cum-price schedule' as part of NIT.

3.0 SPECIFIC TECHNICAL REQUIREMENTS

<u>S.No.</u>	<u>Reference Clause No. of Section- II</u>	<u>Specific Requirement/ Change</u>

4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

- 4.1 Following documents/drawings shall be submitted after placement of order for BHEL & customer's approval:-

Sl. No.	Drawings/Document Description	Drawings / Document Number
1.	Technical Data sheet - LT XLPE power cables	PE-V0-412-507-E111
2.	Cross-sectional Drgs.- LT XLPE Power Cables	PE-V0-412-507-E113
3.	Quality Plan - LT XLPE Power Cables	PE-V0-412-507-E913 *
4.	Steel drum drawing - LT XLPE Power Cables (if applicable)	PE-V0-412-507-E115

Note:

* Standard Quality Plan as enclosed in the technical specification is to be appended with cover sheet bearing document number and description as stated above. The signed and stamped copy of the same shall be submitted to BHEL without making any changes in the contents of the document.



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DATA SHEET-A

1.0	Type of Cable	Flame Retardant Low Smoke (FR-LS)	
2.0	Standard applicable in general(Latest amendment to be referred if any)	IS:7098 (Part-1), IS:8130, IS:5831, IS:10810, IS:3975, ASTMD:2843, ASTMD:2863, IEC-754-1, IEC:60332 (Part-1), IEC:60332-3-23, IEEE:60383	
3.0	Voltage Grade	1.1kV	
4.0	Number of cores, cross sectional area of conductors and quantities	As per BOQ-Cum-Price Schedule	
5.0	FAULT CHARACTERISTICS		
	Fault Level	50kA RMS	
	Fault Clearing Time	0.5 sec – for feeders between two 415V boards (PMCC to MCC) 0.16 sec – for feeders protected by breakers	
6.0	CONDUCTOR		
(a)	Material	Aluminium	Copper
	Grade and Class	Stranded, Compacted, H2, Class 2	Stranded, plain annealed high conductivity, Class 2
(b)	Standard Applicable	IS: 8130	
(c)	Shape	Aluminium	Copper
		Circular – up to 16 sq.mm. Sector – for 25 sq.mm. & above	Circular – for all sizes
(d)	Min. number and diameter of strands for main and neutral conductor [Neutral conductor cross section w.r.t main conductor shall be as per Table-2 of IS: 7098 (Part-1)]	As per Table-2 of IS: 8130	
7.0	INSULATION		
(a)	Material	Cross-Linked Polyethylene(XLPE)	
(b)	Standard Applicable	IS: 7098 (Part-1)	
(c)	Continuous withstand temperature	90°C	
(d)	Short-circuit withstand temperature	250°C	
(e)	Method of application	By extrusion; sleeve extrusion not permitted.	
(f)	Method of curing	Dry/ Steam/ Gas	
(g)	Nominal Thickness of insulation	As per IS: 7098 (Part-1)	
8.0	CORE IDENTIFICATION	As per Cable Identification at S. No. 19 of Datasheet-A	
9.0	INNER SHEATH		
(a)	Material	Extruded PVC Type ST-2	
(b)	Standard Applicable	IS: 7098 (Part-1) & IS: 5831	
(c)	Colour	Black	
(d)	Whether FR-LS	NO	



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(e)	Inner sheath applicable for single core cable	NO
(f)	Fillers	Acceptable
(g)	Material of fillers (if permitted)	Same as inner sheath (Material of filler to be compatible with that of inner sheath)
(h)	Method of application	
(1)	Multi-core cables:	
(i)	With fillers	Pressure/ Vacuum extruded
(ii)	Without fillers	Pressure extruded
(2)	Single-core cables:	NOT APPLICABLE
10.0	ARMOUR	
(a)	Applicable	YES
(b)	Material:	
(i)	Single core cables	Non Magnetic Hard drawn Aluminium Round/ Formed Wire H4 grade to IS: 8130
(ii)	Multi-core cables	Galvanised Steel Round Wire OR Galvanised Steel Formed Wire/Strip, conforming to (i) Type 'a' / 'b' as per Table-6 of IS 7098 part-I and (ii) IS 3975 as per project requirements
(iii)	Standard Applicable	Dimension as per IS: 7098 (Part-1) Table-6 and tolerance on dimension as per IS:3975
(c)	Minimum Coverage	90%
(d)	Gap between armour wires	Shall not exceed one armour wire space (No cross-over/ over-riding)
(e)	Breaking load of joint	95 % of normal armour
(f)	Paint on joint	Zinc rich paint shall be applied on armour joint surface of G.S. wire / formed wire
11.0	OUTERSHEATH	
(a)	Material	PVC Type ST2 as per IS: 5831
(b)	Colour	Black
(c)	Whether FR-LS	Yes
(d)	Method of application	Extruded
(e)	Thickness of outer sheath	As per Table-8 of IS: 7098 (Part-1)
(f)	Marking	Cable size (cross section area and no. of cores), voltage grade and Reference IS @ 5m (by embossing) Word "XLPE", "FR-LS" @ 5m (by embossing) Manufacturer's name and/ or trade name, and year of manufacture @ 5m (by embossing) 'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing) Progressive sequential marking of length of the cable in metres @ 1m (by embossing/ printing) The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.
12.0	FR-LS CHARACTERISTICS	
(a)	Oxygen index	Min 21 (As per NES-715-1)
(b)	Temperature index	Min. 250°C(As per IS 7098-I /ASTMD 2863)
(c)	Acid gas generation	Max. 20% by weight (As per IS 7098-I /IEC-60754-1)
(d)	Smoke density rating	Max. 60% (As per IS 7098-I /ASTM D 2843)



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(e)	Flammability Test	
(i)	Flammability test for single cable	YES As per IEC-60332 Part-1
(ii)	Flammability test for bunched cables	YES As per IEC-60332 Part-3-23, CAT-B
(iii)	Flammability test as per IEEE: 60383	YES
(iv)	As per Swedish Chimney test SEN-SS-424-1475-F3	YES
13.0	Anti-rodent and Termite repulsion Test	YES
14.0	Anti-Fungal Test	YES
15.0	TOLERANCE ON OUTER DIAMETER	Up to 30mm; ± 1.5 mm Above 30mm; $\pm 5\%$ or ± 2 mm, whichever is less.
16.0	MINIMUM BENDING RADIUS	
(a)	Single core cables	15 x O.D.
(b)	Multi core cables	12 x O.D.
17.0	SAFE PULLING FORCE	
(a)	Aluminium conductor cable	30 N/ sq. mm.
(b)	Copper conductor cable	50 N/ sq. mm.
18.0	CABLE DRUMS	
(a)	Type of Drum	Wooden as per IS 10418 OR Steel as per Annexure B to Section II
(b)	Standard drum length	500m ($\pm 5\%$) / 1000m ($\pm 5\%$). (as specified in BOQ-Cum- Priced Schedule)
(c)	Painting	Entire surface to be painted
(d)	Outermost Layer	To be covered with waterproof polyethylene
(e)	Construction Details	Cables shall be supplied in non-returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum.
19.0	CABLE IDENTIFICATION	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted: 1 core - Red, Black, Yellow, Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue & Black For reduced neutral conductors, the core shall be Black.

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DATASHEET C

**GUARANTEED TECHNICAL PARTICULARS
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)**

S.No.		Unit	Description
1.0	General	-	
1.1	Name of manufacturer	-	
1.2	Place of Manufacture	-	
2.0	Standards Applicable		
2.1	IS: 7098 Part-I For general specification of XLPE Cables	-	YES
2.2	IS: 8130 For conductor material	-	YES
2.3	IS: 5831 For material of inner sheath & outer sheath.	-	YES
2.4	IS: 3975 / IS: 8130 For armour of 3 core/ single core cables	-	YES
2.5	IS: 10810 For method of tests	-	YES
2.6	IS:10418 For cable drums	-	YES
2.7	ASTMD-2863 For oxygen index test	-	YES
2.8	ASTMD-2843 For smoke density test	-	YES
2.9	SS:424-14-75 & IEC-332-III-Cat-B & CAT-A, IEC-332-I/ IEEE: 383 For flammability test	-	YES
2.10	IEC-754-1 For Acid gas generation	-	YES
2.11	Current rating of cables conforms to	-	
2.12	Short circuit rating conforms to	-	
2.13	Formula for calculating short circuit current for Different duration	-	
3.0	(a) Installation Conditions at site	deg. C	
	i) Ambient air temperature	deg. C	
	ii) Ground temperature	cm	
	iii) Depth of laying of cables buried in ground	deg. C cm/W	
	(b) Installation conditions for current rating specified at clause 6.3		
4.0	CHARACTERISTICS OF FRLS SHEATH		
	(a) Oxygen index		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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	(b) Temperature index		
	(c) Acid gas generation		
	(d) Smoke density rating		
5.0	CABLE DRUMS		
	(a) Type & construction		
	(b) Standard drum length		
	(c) Tolerance on drum length		
6.0	INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE		
6.1	No. of cores x size		
6.2	Voltage grade (Uo/U)	kV	
6.3	Base current ratings (*) based on Cl. 3.0		
	(a) In air	Amp	
	(b) In ground	Amp	
	(c) ducts	Amp	
6.4	Short circuit rating	kA,Sec	
6.5	(a) D.C. resistance of conductor at 20 deg C	ohm/km	
	(b) A.C. resistance of conductor at 90 deg. C	ohm/km	
	(c) Reactance of cable at Normal frequency	ohm/km	
	(d) Electrostatic capacitance of cable at normal frequency	mF/km	
6.6	CONDUCTOR		
	(a) Material type & grade	-	
	(b) No & dia of wires in each core before stranding	no x mm	
	(c) Shape	-	
6.7	XLPE INSULATION		
	(a) Nominal thickness of insulation	mm	
	(b) Method of Curing	-	
6.8	PVC ST2 INNERSHEATH		
	(a) Material	-	
	(b) Thickness (min.)	mm	
	(c) Method of application	-	
	1. Multi-core cables		
	(i) With fillers		
	(ii) With out fillers	Pressure Extruded	
	2. Single core cables		
	d) Type and shape of fillers (if used)		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

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	e) Colour		
6.9	ARMOUR		
	(a) Material		
	(i) Single core cables		
	(ii) Multi-core cables		
	(b) Size/ dimensions		
	(c) Minimum no. of wires /formed wires		
	(d) Tolerance on formed wire dimension		
	(e) Maximum resistivity of GS formed wire		
	(f) Maximum resistivity of Aluminium round wire		
6.10	PVC ST2 FRLS OUTERSHEATH		
	(a) Nominal thickness of outer sheath	mm	
6.11	DIAMETERS		
	(a) Diameter of insulated conductor	mm	
	(b) Cable diameter under armour	mm	
	(c) Cable diameter over armour	mm	
	(d) Overall diameter of cable	mm	
6.12	Tolerance on overall diameter	(±) mm	
6.13	Minimum bending radius	x O.D	
6.14	Safe Pulling Force	kG	
6.15	Weight of cable	kg./km	
	(a) Weight of conductor	MT/km	
	(b) Weight of XLPE insulation	MT/km	
	(c) Weight of PVC (Inner Sheath, Outer Sheath & Fillers)	kg./km	
	(d) Weight of Armour (As applicable)	kg./km	
6.16	Dimension of drum	mm	
6.17	Shipping weight	kg	
6.18	Cable marking on outer sheath		

(*) For single core cables, the continuous current rating shall be furnished separately for armour earthed at one end and at both ends.

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



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SECTION – II

GENERAL TECHNICAL SPECIFICATION



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1.0 TECHNICAL REQUIREMENTS

- 1.1 Technical requirements for LT XLPE POWER CABLES shall be as indicated in this section, in addition to those specified in Section I & Datasheet-A.
- 1.2 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation at site conditions.

2.0 CODES & STANDARDS

- 2.1 The design, material, construction, manufacture, inspection, testing and performance of LT XLPE POWER CABLES shall conform to the latest revision of relevant standards and codes of practices mentioned in Data Sheet - A.
- 2.2 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

3.0 QUALITY ASSURANCE REQUIREMENTS

- 3.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E002 as attached with the specification without any deviations. At contract stage, the successful bidder shall submit the same QP for BHEL/ultimate customer's approval. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ultimate customer's approval. There shall be no commercial implication to BHEL on account of minor changes in QP during contract stage.
- 3.2 All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved Quality Plan.
- 3.3 Type testing requirements, routine / acceptance testing and special testing requirements shall be as per Annexure – A to QP. Charges for all these tests for all the equipment & components shall be deemed to be included in the bid price (except UV Radiation & Hydraulic Stability test).
- 3.4 The charges of UV Radiation test & Hydrolytic Stability test (if applicable) shall be reimbursed extra at actual against original money receipt of Govt. Lab. (CPRI/ ERDA etc.).
- 3.5 Cost of cables consumed for testing shall be to bidder's account.

4.0 Packing

- 4.1 Cables shall be supplied in non-returnable drums. Material of cable drums shall be as specified in Datasheet-A.
- 4.2 In case of wooden drums, all wooden parts shall be manufactured from seasoned wood treated with copper naphthenates / zinc naphthenates (refer IS: 401). Dimensions of wooden drums shall be as per IS 10418. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. BIS certification mark shall be stamped on each cable drum. Over the cables polyethylene sheet shall be wrapped and then sealed properly.
- 4.3 In case of Steel drums, New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. For Typical details of Steel drums, Annexure-B to Section-II, may be referred by the bidder. Bidder may modify, to choose appropriate dimensions of steel drums to suite various sizes/weight/ lengths of LT XLPE POWER CABLES.

		STANDARD QUALITY PLAN		CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD.		PROJECT TITLE: 2 X 660MW ENNORE SEZ SUPERCRITICAL TPP		SPECIFICATION NUMBER: PE-TS-412-507-E012				
				BIDDER/ VENDOR: SYSTEM		QUALITY PLAN NUMBER: PE-QP-999-507-E002, R01 ITEM : LT XLPE Power Cables		SPECIFICATION TITLE: TECH. SPEC. FOR LT XLPE POWER CABLES				
		SHEET 1 OF 9						SECTION : 2		VOLUME II		
SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS	
									P	W		V
1	2	3	4	5	6	7	8	9	10		11	
Instructions: 1. Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch/ lot no. should be traceable to the final cable drum number or batch no. 2. Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not.												
1.0	RAW MATERIALS & BOUGHT OUT ITEMS											
1.1	Aluminium /Copper Rods (Conductor/ Armour Wire)	GENERAL : 1. Physical properties	MA	Physical Tests	Sample/ Batch	IS:7098-I,IS:5082, IS:5484, IS:8130 & Appd Datasheet	IS:7098-I,IS: 5082, IS:5484, IS:8130 & Appd Datasheet	Inpection Report/ Test Cert.	2/3	-	1/2	
		2. Elec.Properties	MA	Electrical Tests	Sample/ Batch	-do-	-do-	-do-	2/3	-	1/2	
		SPECIFIC CHECKS : a) Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	2/3	-	1	
		b) Grade	MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	2/3	-	1	
		c) Resistivity	MA	Electrical Tests	Manufacturer std.	IS 8130, IS 5082	IS 8130, IS 5082	-do-	2/3	-	1	
1.2		XLPE Compound for insulation	GENERAL : 1. Physical properties	MA	Physical Tests	Sample/ Batch	IS 7098-I & Mfs Std./ Approved datasheet	IS 7098-I & Mfs Std./ Approved datasheet	Inpection Repor/ Test Cert.	2/3	-	1/2
			2. Elec.Properties	MA	Electrical Tests	Sample/ Batch	-do-	-do-	-do-	2/3	-	1/2
			SPECIFIC CHECKS : a) Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	2/3	-	1
			b) Type/ Grade	MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	2/3	-	1
			c) Shelf life/ Storage condition	MA	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	2/3	-	1
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		STANDARD QUALITY PLAN		CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD.		PROJECT TITLE: 2 X 660MW ENNORE SEZ SUPERCRITICAL TPP		SPECIFICATION NUMBER: PE-TS-412-507-E012						
				BIDDER/ VENDOR:		QUALITY PLAN NUMBER: PE-QP-999-507-E002, R01		SPECIFICATION TITLE: TECH. SPEC. FOR LT XLPE POWER CABLES						
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SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS		
									P	W	V			
1	2	3	4	5	6	7	8	9	10			11		
1.3	PVC Compound (for sheath)	GENERAL :												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	IS 7098-I, IS 5831& Mfr. Std./ Approved datasheet	IS 7098-I, IS 5831& Mfr. Std./ Approved datasheet	Inspection Report/ Test Cert.	2/3	-	1/2			
		2. Elec.Properties	MA	Electrical Tests	Sample/ Batch	-do-	-do-	-do-	2/3	-	1/2			
		3. FRLS Properties (as applicable)	CR	Chemical/ Environ.	Sample/ Batch	-do-	-do-	-do-	2/3	-	1/2			
		SPECIFIC CHECKS :												
		a) Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	2/3	-	1			
		b) Type/ Grade	MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	2/3	-	1			
		c) Shelf life/ Storage condition	MA	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	2/3	-	1			
		1.4	Fillers (as applicable)	1. Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	2/3	-	1	
				2. Type/ Grade	MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	2/3	-	1	(Fillers material chosen shall be compatible with the temerature rating of the cable and shall have no deleterious effect on any other componenet of the cable)
BHEL			PARTICULARS		BIDDER/VENDOR									
			NAME											
			SIGNATURE											
			DATE					BIDDER'S/VENDORS COMPANY SEAL						

		STANDARD QUALITY PLAN		CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD.		PROJECT TITLE: 2 X 660MW ENNORE SEZ SUPERCRITICAL TPP		SPECIFICATION NUMBER: PE-TS-412-507-E012				
				BIDDER/ VENDOR:		QUALITY PLAN NUMBER: PE-QP-999-507-E002, R01		SPECIFICATION TITLE: TECH. SPEC. FOR LT XLPE POWER CABLES				
		SHEET 3 OF 9		SYSTEM		ITEM : LT XLPE Power Cables		SECTION :2 VOLUME II				
SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.5	Galvanised steel wire/strip for Armour (as applicable)	GENERAL : 1. Make 2. Dimension 3. Phy.and Elec. Properties 4.Galvanization Quality	MA	Verify	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Inpection Report/ Test Cert.	2/3	-	1	* Sample from each armour size/ Batch / Lot
			MA	Measurement	-do-	IS 7098-I, IS 3975 & Approved datasheet	IS 7098-I, IS 3975 & Approved datasheet	-do-	2/3	-	2	
			MA	Physical & Electrical Tests	Sample*	-do-	-do-	-do-	2/3	-	2	
			MA	Galv.Tests	-do-	IS 3975 & Mfr. Std.	IS 3975 & Mfr. Std.	-do-	2/3	-	2	
1.6	Wooden Drum	1. Phy. & Constructional checks	MA	Visual	Mfr's Plant Std.	IS 10418	IS 10418	Inpection Report/ Test Cert.	2/3	-	1	
		2. Anti termite treatment	MA	Chem.	Mfr's Plant Std.	Mfr's Plant Std.	Mfr's Plant Std.	COC	2/3		1	
1.7	Steel Drum #	1. Dimension	MA	Meas.	Mfr's Plant Std.	Approved drawing of steel drum / BHEL specification	Approved drawing of steel drum / BHEL specification	Inpection Report/ Test Cert.	2/3	-	1	# (If Applicable)
		2. Surface finish	MA	Meas.	-do-	Surface shall be smooth	Surface shall be smooth	-do-	2/3		1	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
									BIDDER'S/VENDORS COMPANY SEAL			

		STANDARD QUALITY PLAN		CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD.		PROJECT TITLE: 2 X 660MW ENNORE SEZ SUPERCRITICAL TPP			SPECIFICATION NUMBER: PE-TS-412-507-E012			
				BIDDER/ VENDOR:		QUALITY PLAN NUMBER: PE-QP-999-507-E002, R01			SPECIFICATION TITLE: TECH. SPEC. FOR LT XLPE POWER CABLES			
		SHEET 4 OF 9		SYSTEM		ITEM : LT XLPE Power Cables			SECTION :2 VOLUME II			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	Wire Drawing	1. Size	MA	Dimensional	Plant Mfg. Std.	IS 8130 & Appd. Datasheet	IS 8130 & Appd. Datasheet	Inpection Report	2	-	1	# To be checked at starting & finished end of extruded length.
		2. Surface finish	MA	Visual	-do-	Surface shall be smooth	Surface shall be smooth	-do-	2	-	1	
		3. % of Elongation	MA	Mechanical	-do-	IS 8130 & Appd. Datasheet	IS 8130 & Appd. Datasheet	-do-	2	-	1	
2.2	Stranding of wires	1. No. of wires	MA	Counting	Plant Mfg. Std.	IS 8130 & Appd. Datasheet	IS 8130 & Appd. Datasheet	Inpection Report	2	-	-	
		2. Resistance	CR	Electrical	-do-	-do-	-do-	-do-	2	-	-	
		3. Sequence, lay length & Direction	MA	Visual, Meas.	One Sample of each size/ lot	Mfrs Std. / Appd. Datasheet	Mfrs Std. / Appd. Datasheet	-do-	2	-	-	
		4. Surface Finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	-do-	2	-	-	
		5. Dimension	MA	Measurement	One Sample of each size/ lot	IS 8130 & Appd. Datasheet	IS 8130 & Appd. Datasheet	-do-	2	-	-	
2.3	Core Insulation (XLPE) (No repair permitted)	1. Surface finish	MA	Visual	100%	Free from bulging, burnt particles, lumps, cuts & scratches	Free from bulging, burnt particles, lumps, cuts & scratches	Inpection Report	2	-	1	
		2. Eccentricity & Ovality #	CR	Measurement	One Sample of each size/ lot	IS 7098-I & Appd. Datasheet	IS 7098-I & Appd. Datasheet	-do-	2	-	1	
		3. Insulation Thickness	CR	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		4. Dia over insulation	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		5. Tensile Strength & % Elongation	MA	Mechanical	100%	-do-	-do-	-do-	2	-	-	
		6. Spark Test or Water immersion test	CR	Electrical	100%	Mnfr's Std	Mnfr's Std	-do-	2	-	1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		STANDARD QUALITY PLAN		CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD.		PROJECT TITLE: 2 X 660MW ENNORE SEZ SUPERCRITICAL TPP		SPECIFICATION NUMBER: PE-TS-412-507-E012					
				BIDDER/ VENDOR:		QUALITY PLAN NUMBER: PE-QP-999-507-E002, R01		SPECIFICATION TITLE: TECH. SPEC. FOR LT XLPE POWER CABLES					
SHEET 5 OF 9		SYSTEM		ITEM : LT XLPE Power Cables		SECTION :2		VOLUME II					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.4	Core Laying	1. Dia over laid up core 2. Sequence of lay & direction 3. Lay Length	MA	Measurement	One Sample of each size/ lot	IS 7098-I & Appd. Datasheet	IS 7098-I & Appd. Datasheet	Inspection Report	2	-	-		(Pimple, fish eye, porosity & burnt particles not permitted.)
			MA	Visual & Meas.	-do-	IS 7098-I & Mfr. Std.	IS 7098-I & Mfr. Std.	-do-	2	-	-		
			MA	Measurement	-do-	-do-	-do-	-do-	2	-	-		
2.5	InnerSheath Extrusion (as applicable)	1. Surface finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inspection Report	2	-	-		
		2. Thickness	CR	Measurement	One Sample of each size/ lot	IS 7098-I & Appd. Datasheet	IS 7098-I & Appd. Datasheet	-do-	2	-	-		
		3. Dia over inner sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-		
2.6	Armour(as applicable)	1. No.of wires/Strips	MA	Counting	At the start of the process	IS 7098-I & Appd. Datasheet	IS 7098-I & Appd. Datasheet	Inspection Report	2	-	-		
		2. Lay length & Direction	MA	Visual & Meas.	-do-	IS 7098-I & Mfr. Std.	IS 7098-I & Mfr. Std.	-do-	2	-	-		
		3. Dia over armouring	MA	Measurement	-do-	IS 7098-I & Appd. Datasheet	IS 7098-I & Appd. Datasheet	-do-	2	-	-		
		4. Coverage	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-		
2.7	Outer Sheath Extrusion (No repair permitted)	1. Surface finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inspection Report	2	-	-		
		2. Sheath Thickness	CR	Measurement	One Sample of each size/ lot	IS 7098-I & Appd. Datasheet	IS 7098-I & Appd. Datasheet	-do-	2	-	-		
		3. Dia over outer sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-		
		4. Embossing/ Sequential Marking	MA	Visual	100%	Approved data sheet	Approved data sheet	-do-	2	-	-		
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE						BIDDER'S/VENDORS COMPANY SEAL				

		STANDARD QUALITY PLAN		CUSTOMER : TAMILNADU GENERATION & DISTRIBUTION CORP. LTD.		PROJECT TITLE: 2 X 660MW ENNORE SEZ SUPERCRITICAL TPP		SPECIFICATION NUMBER: PE-TS-412-507-E012				
				BIDDER/ VENDOR:		QUALITY PLAN NUMBER: PE-QP-999-507-E002, R01		SPECIFICATION TITLE: TECH. SPEC. FOR LT XLPE POWER CABLES				
		SHEET 6 OF 9		SYSTEM		ITEM : LT XLPE Power Cables		SECTION :2		VOLUME II		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
3.0	Finished Cable (INTERNAL)	1. Routine Test (Refer Note-F)	CR	Electrical Tests & Measurement	100%	IS 7098-I & Appd. Datasheet	IS 7098-I & Appd. Datasheet	Test Report	2	-	1	# Refer Annexure-A to QAP enclsloed
4.0	Final Inspection (EXTERNAL)	1. Finish	MA	Visual	One drum in each Lot	IS 7098-I & Appd. Datasheet	Free from Porosity, Bulging, Burnt particles,lumps, cuts & scratches	Test Report	2	1	-	
		2. Length	MA	Measurement	-do-	-do-	Approved Data Sheet	-do-	2	1	-	
		3. Dimension	MA	-do-	As per IS	-do-	-do-	-do-	2	1	-	
		4. Armouring - Coverage & No.of Wires/Strips	MA	Visual & Meas.	-do-	-do-	-do-	-do-	2	1	-	
		5. Marking & Colour Coding	MA	Visual	As per IS	-do-	Approved Data Sheet	-do-	2	1	-	
		6. Acceptance Tests (Refer Note-F)	CR	Phy, Elect. Tests & FRLS Tests	-do-	-do-	-do-	-do-	2	1	-	
		7. Type Tests (Refer Note-F)	CR	Physical & Electrical Tests	Sample #	-do-	-do-	-do-	2	1	-	
5.0	Packing	Sealing Identification	MA	Visual	100%	As per IS	As per IS	-do-	2	1	-	
NOTES:- (A) JOINTS IN WIRE SHALL BE AS PERMITTED BY IS / MANUFACTURER'S STANDARD, VENDOR TO CERTIFY THE SAME. (B) NO REPAIR OF CORE INSULATION PERMITTED (C) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER. (D) FILLERS/DUMMY CORES ETC. SHALL BE AS PER APPROVED DATA SHEET (E) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER BHEL SPECIFICATION. (F) FOR LIST OF ROUTINE, TYPE & ACCEPTANCE TESTS, REFER ANNEXURE-A TO QAP ENCLOSED.												
LEGEND : P: PERFORMER W: WITNESSER V: VERIFIER 1- BHEL/CUSTOMER 2-VENDOR 3- SUB VENDOR CHP: CUSTOMER HOLD POINT WHICH WILL BE DECIDED AT CONTRACT STAGE												
		BHEL				PARTICULARS		BIDDER/ VENDOR				
						NAME						
						SIGNATURE						
						DATE						BIDDER'S/VENDORS COMPANY SEAL

	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER: PE-TS-412-507-E012
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E002, R01	SPECIFICATION TITLE:
	SHEET 7 OF 9	SYSTEM	ITEM: LT XLPE POWER CABLES	DOC. NO.

TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS

A. Type Test Conduction:

- Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.
- Sampling:
 - Type test to be conducted on one size of cable for every lot and type of cable (CU/AL conductor)
 - Flammability Test to be conducted only on one sample/ lot.

B. Acceptance Test Conduction:

- Tests for which "A" is indicated in the 'Test Conduction Required As' column below shall be conducted as Acceptance tests.
- Sampling:
Sampling for acceptance tests shall be as per following sampling plan:

S. NO.	NO. OF DRUMS IN THE LOT	NO. OF DRUMS TO BE TAKEN AS SAMPLE
1.	Up to 100	10% (Subject to minimum of 1 drum)
2.	101 to 300	13
3.	301 to 500	20
4.	Above 500	32

- Flammability Test to be conducted only on one sample/ lot.

C. Routine Test Conduction:

- Tests for which "R" is indicated in the 'Test Conduction Required As' column below shall be conducted as Routine tests.

D. Tests listed in S.No-7.0 & 8.0 shall be conducted only on one sample / lot.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	Tests for Conductor				
I.	Annealing test	For copper conductor only	T, A	IS 10810 Pt 1	<u>Internal in process Test Report to be furnished for acceptance test</u>
II.	Tensile test	For aluminium conductor only (Not applicable for compacted circular or shaped conductor)	T, A	IS 10810 Pt 2	
III.	Wrapping test	For aluminium conductor only (Not applicable for compacted circular or shaped conductor)	T, A	IS 10810 Pt 3	

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	SIGNATURE		
	DATE		BIDDER'S / VENDORS COMPANY SEAL

	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER: PE-TS-412-507-E012
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E002, R01	SPECIFICATION TITLE:
	SHEET 8 OF 9	SYSTEM	ITEM: LT XLPE POWER CABLES	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
IV.	Resistance test	For Al/Cu	T, A, R	IS 10810 Pt 5	
2.0	<u>Tests for Armour Wires/Strips</u>				
I.	Measurement of dimensions	Applicable for Aluminium wire & GS wire/Strip	T,A	IS 10810 Pt 36	
II.	Tensile test	Applicable for Aluminium wire & GS wire/Strip	T, A	IS 10810 Pt 37	
III.	Elongation at break test	Applicable for GS wire/Strip only	T, A	IS 10810 Pt 37	
IV.	Torsion test	For GS round wire only	T, A	IS 10810 Pt 38	
V.	Winding test	For GS strip only	T, A	IS 10810 Pt 39	
VI.	Resistivity test	Applicable for Aluminium wire & GS wire	T, A	IS 10810 Pt 42	
VII.	Uniformity of Zinc coating test	For G. S. wires/Strip only	T, A	IS 10810 Pt 40	
VIII.	Mass of Zinc coating test	For G. S. wires/Strip only	T, A	IS 10810 Pt 41	
IX.	Wrapping Test	For Aluminium wires only	T, A	IS 10810 Pt 3	
3.0	<u>Physical Tests for XLPE Insulation & PVC sheath</u>				
I.	Test for thickness	Applicable for XLPE insulation, PVC inner sheath & PVC outer sheath	T, A	IS 10810 Pt 6	
II.	Tensile strength and elongation test at break	Applicable for XLPE insulation & PVC outer sheath			
(a)	Before ageing		T, A	IS 10810 Pt 7	
(b)	After ageing		T, A	IS 10810 Pt 7	
III.	Ageing in air oven	Applicable for XLPE insulation & PVC outer sheath	T, A	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	For PVC outer sheath only	T, A	IS 10810 Pt 10	
V.	Hot deformation test	For PVC outer sheath only	T, A	IS 10810 Pt 15	
VI.	Heat shock test	For PVC outer sheath only	T, A	IS 10810 Pt 14	
VII.	Shrinkage test	For XLPE insulation & PVC outer sheath only	T, A	IS 10810 Pt 12	
VIII.	Thermal stability test	For PVC outer sheath only	T, A	IS 10810 Pt 60	
IX.	Hot set test	For XLPE insulation only	T, A	IS 10810 Pt 30	
X.	Water absorption (gravimetric) test	For XLPE insulation only	T, A	IS 10810 Pt 33	
4.0	<u>Improved Fire performance (FR-LS) Tests</u>				
I.	Oxygen index test	For PVC outer sheath only	T, A	IS 10810 Pt 58 / ASTM D 2863	Min. 29

BHEL	PARTICULARS	BIDDER/ VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S / VENDORS COMPANY SEAL

	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER: PE-TS-412-507-E012
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E002, R01	SPECIFICATION TITLE:
	SHEET 9 OF 9	SYSTEM	ITEM: LT XLPE POWER CABLES	DOC. NO.

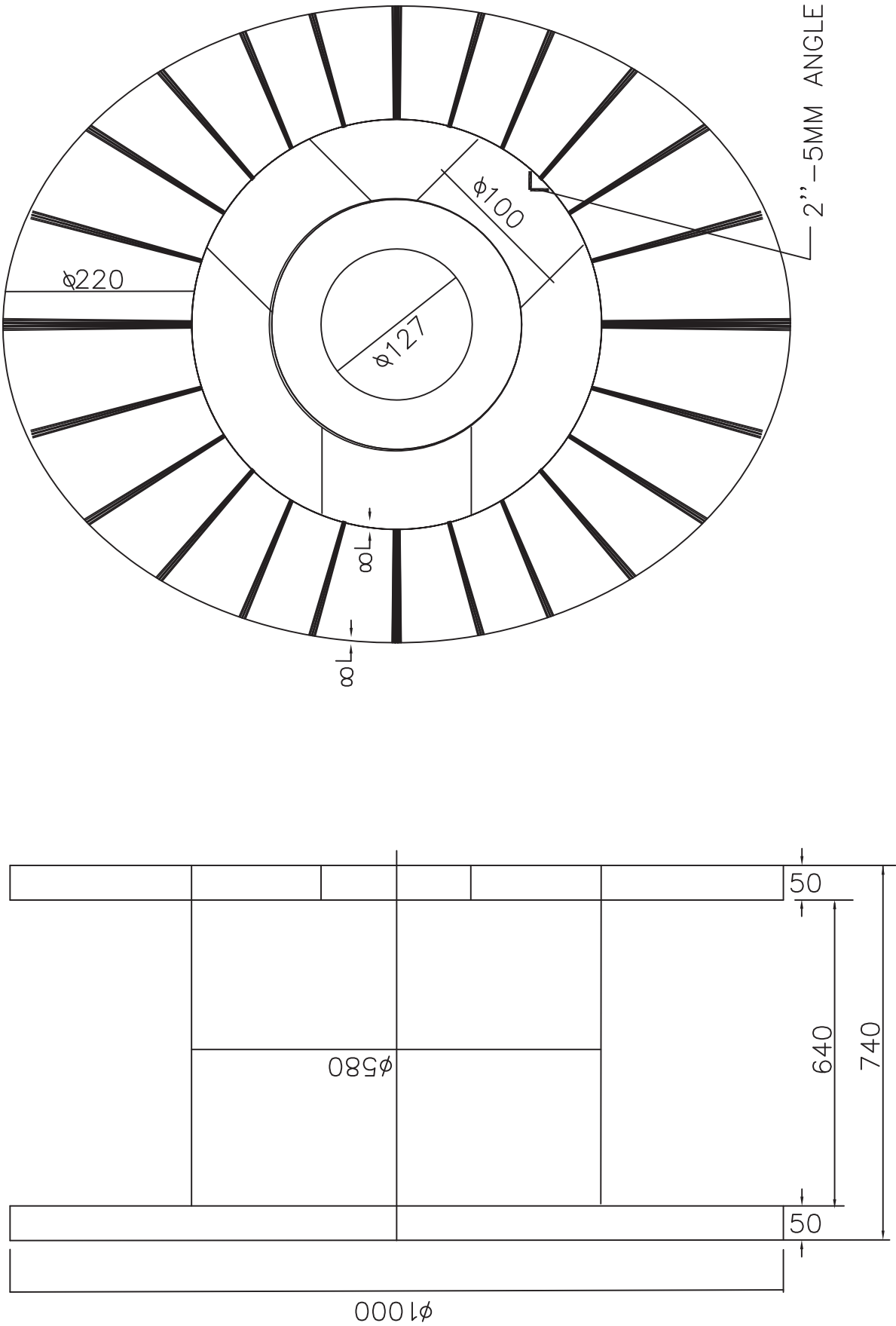
S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
II.	Smoke density test	For PVC outer sheath only	T, A	IS 10810 Pt 63 / ASTM D 2843	Max. 60%
III.	Acid gas generation test	For PVC outer sheath only	T, A	IS 10810 Pt 59 / IEC-754-1	Max. 20% by weight
IV.	Temperature Index Test	For PVC outer sheath only	T, A	IS 10810 Pt 64 / ASTM D 2863	Min. 250 °C
5.0	Flammability Tests				
I.	Flammability test for bunched cables	For complete cable	T	IS 10810 Pt 62/ IEC-60332 (Part-3-23-Cat-B)	
II.	Flammability test for single cable	For complete cable	T,A	IS: 10810 Pt 61 / IEC:60332 Part-1	
III.	Swedish chimney test	For complete cable	A	SEN SS 424 1475 (Class F3)	
IV.	Flammability test	For complete cable	T, A	IEEE: 60383	
6.0	Electrical Tests				
I.	High Voltage Test	For complete cable	T, A, R	IS 10810 Pt 45	
II.	Insulation Resistance Test (Volume resistivity method)	For complete cable	T, A	IS 10810 Pt 43	
7.0	Anti-rodent and Termite Repulsion test	For PVC outer sheath only	A	--	
8.0	Cold Impact Test	For PVC outer sheath only	A	IS 5831	

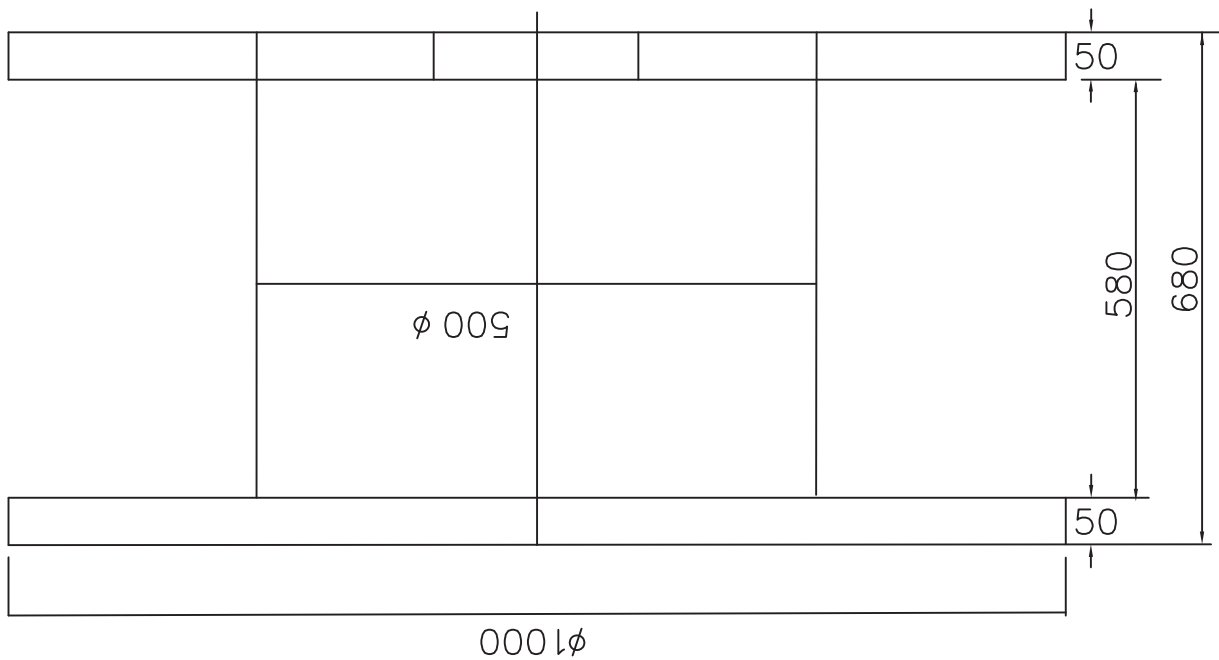
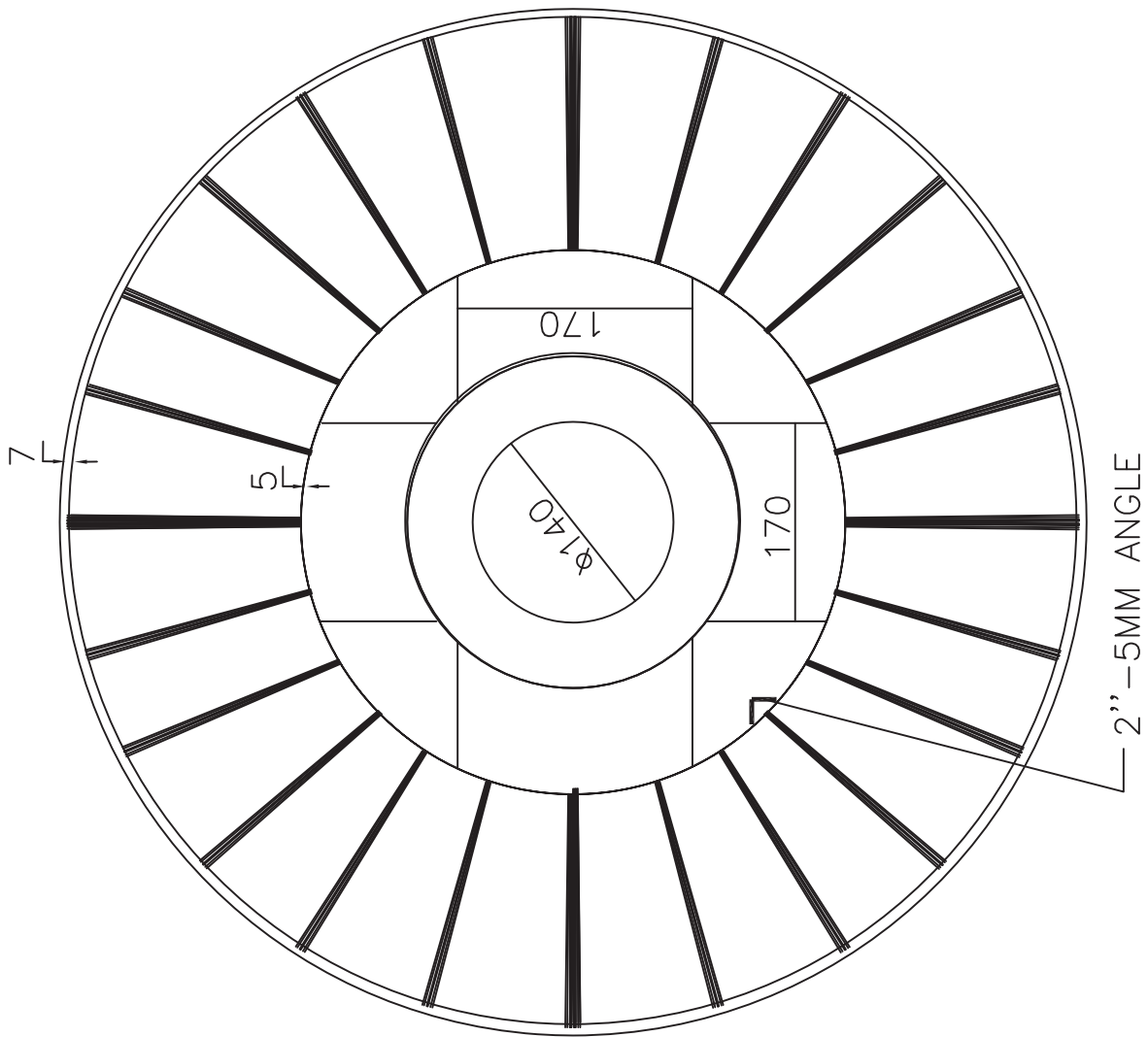
BHEL	PARTICULARS	BIDDER/ VENDOR	
	NAME		
	SIGNATURE		
	DATE		BIDDER'S / VENDORS COMPANY SEAL

STEEL DRUM DRAWING (TYPICAL)

ANNEXURE-B TO SECTION-II

(Sheet 1 of 2)





DIMENSION in mm