VOLUME II

NTPC-SAIL POWER COMPANY (P) LIMITED

1 X 250 MW ROURKELA PP-II EXPANSION PROJECT

TECHNICAL SPECIFICATION

FOR

HT XLPE POWER CABLES

SPECIFICATION NO: ***PE-TS-427-507-E001***

REVISION: **0**

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UP (INDIA) – 201301

CONTENTS

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

SECTION –I

SPECIFIC TECHNICAL REQUIREMENTS

1.0 SCOPE OF ENQUIRY

1.1 This specification covers the Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of HT XLPE POWER CABLES.

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.

1.3 General technical requirements of the HT XLPE POWER CABLES are indicated in Section-II. Project specific technical/ quality requirements / changes are listed in Section-I.

1.4 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.

1.5 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 TECHNICAL REQUIREMENTS

3.1 Specific Technical Requirement:

S.No.	***Reference Clause No. of Section- II***	***Specific Requirement/ Change***

3.2 Quality/ Inspection:

S.No.	***Reference Clause No. of Section- II***	***Specific Requirement/ Change***
1.	Clause No. 3.1	Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E001 **(this quality plan shall be read in conjunction with attached Annexure C - Quality Assurance & Inspection)** 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.

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 for HT XLPE Power Cables	PE-V0-427-507-E101
2.	Cross-sectional Drawings for HT XLPE Power Cables	PE-V0-427-507-E102
3.	Manufacturing Quality Plan for HT XLPE Power Cables	PE-V0-427-507-E912 *
4.	Steel drum drawing for HT XLPE Power Cables (if applicable)	PE-V0-427-507-E105

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.

DATASHEET A

1.0	Type of Cable	Flame Retardant-Low Smoke (FR-LSH)	
2.0	Standard applicable in general (Latest amendment to be referred if any)	IS:7098 (Part-2), 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	6.35/ 11kV (Earthed)	19/ 33 kV (Earthed)
4.0	Number of cores, cross sectional area of conductors and quantities	As per Annexure-C	
5.0	CONDUCTOR		
(a)	Material	Aluminium	
	Grade and Class	Multi-Stranded, H2, Class 2	
(b)	Standard Applicable	IS: 8130	
(c)	Shape	Compacted Circular	
(d)	Min. number and diameter of strands	As per Class-2 of IS: 8130	
(e)	Conductor screen		
(i)	Material	Extruded Cross-linked Semi-conducting compound	
(ii)	Minimum thickness	0.3 mm	
6.0	INSULATION		
(a)	Material	Cross-Linked Polyethylene(XLPE)	
(b)	Standard Applicable	IS: 7098 (Part-2)	
(c)	Continuous withstand temperature	90°C	
(d)	Short-circuit withstand temperature	250°C	
7.0	INSULATION SCREEN	For both SINGLE CORE & MULTI CORE cables	
(a)	Non-metallic		
(i)	Material	Extruded Cross-linked Semi-conducting compound	
(ii)	Type of Semiconducting compound	Bonded	
(iii)	Minimum thickness	0.3 mm	
(b)	Metallic		
(i)	Material	Copper	
(ii)	Type	Tape	
(iii)	Size	Nominal thickness 0.1mm with tolerance (±) 10%	
(iv)	Minimum Overlap	20%	
(c)	Earth fault current withstand capacity	400A, 2 sec (For multi-core cables, screen of each core shall be rated individually for the above value).	
8.0	EXTRUSION (Insulation and Screens)		
(a)	Process	Triple Extrusion (Extruded semi-conducting compound conductor screen and insulation screen shall be applied along with XLPE insulation in a single operation by triple extrusion process).	
(b)	Method of Curing	1. Dry curing/ Gas curing for 19/ 33 kV (E) Cables 2. Dry curing/ Gas curing/ Steam curing for 6.35/ 11 kV (E) Cables	

9.0	CORE IDENTIFICATION	Colour coding as per IS:7098(Part-2)
10.0	INNER SHEATH	For MULTI CORE cables ONLY
(a)	Material	PVC Type ST-2
(b)	Standard Applicable	IS: 7098 (Part-2) & IS: 5831
(c)	Colour	Black
(d)	Whether FR-LSH	NO
(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 extruded [√]Vacuum extruded
(ii)	Without fillers	Pressure extruded
(i)	Thickness of inner sheath	As per Table-5 of IS: 7098 (Part-2)
11.0	ARMOUR	
(a)	Applicable	NO
12.0	OUTERSHEATH	
(a)	Material	PVC Type ST2 as per IS: 5831
(b)	Colour	Black
(c)	Whether FR-LSH	Yes
(d)	Method of application	Extruded
(e)	Thickness of outer sheath	As per Table-7 of IS: 7098 (Part-2)
(f)	Marking	(A) Following shall be marked @ 5m (by embossing): 1. Cable size (cross section area and no. of cores) and voltage grade 2. Word "XLPE" "FR-LSH" 3. Screen fault current (Value of current & time) 4. Manufacturer's name and/ or trade name, and year of manufacture 5. 'BHEL-PEM' and 'CUSTOMER' Name (B) Progressive sequential marking of length of the cable in metres @ 1m (by embossing/ printing)
13.0	FR-LSH CHARACTERISTICS	
(a)	Oxygen index	Min 29 (As per IS 7098-2 /ASTMD 2863)
(b)	Temperature index	Min. 250^{o}C(As per IS 7098-2 /ASTMD 2863)
(c)	Acid gas generation	Max. 20% by weight (As per IS 7098-2 /IEC-60754-1)
(d)	Smoke density rating	Max. 60% (As per IS 7098-2 /ASTM D 2843)
(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, CAT-B
14.0	TOLERANCE ON OUTER DIAMETER	(±)2 mm. over the declared value

15.0	CABLE DRUMS	
(a)	Type of Drum	[√] Wooden as per IS 10418 [√] Steel as per relevant IS
(b)	Standard drum length	1000M (±) 5% for Single core cables 750M (±) 5% for Multi-core cables
(c)	Painting	Entire surface to be painted
(d)	Outermost Layer	To be covered with waterproof polyethylene
(e)	Others	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.
(f)	Particular information on Drum	Each drum shall carry manufacturer's name, owner's name, address and contract no., item no. & type, size & length of cable and net gross weight stencilled on both sides of drum. A tag containing same information shall be attached to the leading end of the cable. An arrow & suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

DATASHEET C

GUARANTEED TECHNICAL PARTICULARS
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

S.No.	Particulars	Unit	Description
1.0	GENERAL		
1.1	Name of Manufacturer	-	
1.2	Place of Manufacture	-	
2.0	STANDARDS APPLICABLE		
2.1	IS: 7098 Part-2 For general specification of XLPE Cables	YES	
2.2	IS: 8130 For conductor material	YES	
2.3	IS: 5831 For material of innersheath & outersheath	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	ASTMD-2863 For oxygen index test	YES	
2.7	SS:424-14-75 & IEC-60332-3 & IEC-60332-1 & IEEE: 60383 For flammability test	YES	
2.8	IEC-60754-1 For acid gas generation test	YES	
2.9	ASTMD-2843 For smoke generation test	YES	
2.10	Current rating of cables conforms to	-	
2.11	Short circuit rating conforms to	-	
2.12	Formula for calculating short circuit current for different durations	-	
3.0	INSTALLATION CONDITIONS AT SITE		
3.1	Ambient air temperature	deg. C	
3.2	Ground temperature	deg. C	
3.3	Depth of laying of cables buried in ground	cm	
3.4	Thermal resistivity of soil	deg. C cm/W	

4.0	INSTALLATION CONDITIONS FOR CURRENT RATING SPECIFIED AT CLAUSE 7.3		
5.0	CHARACTERISTICS OF FR-LSH SHEATH		
5.1	Oxygen index	-	
5.2	Temperature index	-	
5.3	Acid gas generation	-	
5.4	Smoke density rating	-	
6.0	CABLE DRUMS		
6.1	Type & construction	-	
6.2	Standard drum length	-	
6.3	Tolerance on drum length	-	
7.0	INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE		
7.1	No. of cores x size	-	
7.2	Voltage grade (Uo/U)	kV	
7.3	Base current ratings (*) based on Clause No. 3.0		
a)	In air	Amp	
b)	In ground	Amp	
c)	ducts	Amp	
7.4	Short circuit rating	kA, sec	
7.5	Properties		
a)	D.C. resistance of conductor at20 deg. C	ohm/km	
b)	A.C. resistance of conductor at90 deg. C	ohm/km	
c)	Reactance of cable at normal frequency	ohm/km	
d)	Electrostatic capacitance of cable at normal frequency	mF/km	
7.6	CONDUCTOR		
a)	Material type & grade	-	
b)	No & dia of wires in each core before stranding	no x mm	
c)	Shape	-	

7.7	CONDUCTOR SCREEN		
a)	Material	-	
b)	Minimum thickness	mm	
7.8	XLPE INSULATION		
a)	Nominal thickness of insulation	mm	
b)	Method of curing	-	
7.9	INSULATION SCREEN		
a)	Type of screen	-	
b)	Material and thickness (minimum and nominal)	mm	
i)	Metallic	-	
	No. of tapes and Minimum overlapping	-	
ii)	Non-metallic	-	
iii)	Earth fault current withstand capacity (calculation to be furnished)	kA, sec.	
7.10	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 & Shape of fillers (if used)	-	
e)	Colour	-	
7.11	ARMOUR		
a)	Material	-	
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 Al round wire	-	
7.12	PVC/POLYETHYLENE ST2 FR-LSH OUTERSHEATH		
a)	Nominal thickness of outer sheath	mm.	

7.13	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.	
7.14	Tolerance on overall diameter	(±) mm	
7.15	Minimum bending radius	x O.D.	
7.16	Safe pulling force	kg.	
7.17	Weight of cable	kg./km	
a)	Weight of conductor	MT./km	
b)	Weight of XLPE insulation	MT./km	
c)	Weight of PVC (Inner Sheath & Fillers)	kg./km	
d)	Maximum resistivity of GS formed wire	kg./km	
e)	Weight of PVC/Polyethylene (Outer Sheath & Fillers)	kg./km	
7.18	Dimension of drum	mm.	
7.19	Shipping weight	kg	
7.20	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.

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SECTION – II

GENERAL TECHNICAL SPECIFICATION

1.0 TECHNICAL REQUIREMENTS

1.1 Technical requirements for HT XLPE POWER CABLES shall be as indicated in this section, in addition to those specified in Section I & Datasheet-A.

2.0 CODES & STANDARDS

2.1 The design, material, construction, manufacture, inspection, testing and performance of HT 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-E001 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 napthenates / zinc napthenates (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 HT XLPE POWER CABLES. BIS certification mark shall be stamped on each cable drum.

QUALITY PLAN

	STANDARD QUALITY PLAN		CUSTOMER : NTPC-SAIL POWER COMPANY (P) LIMITED			PROJECT TITLE: 1 X 250 MW ROURKELA PP-II EXPANSION PROJECT			SPECIFICATION NUMBER:			PE-TS-427-507-E001
			BIDDER/ VENDOR:			QUALITY PLAN NUMBER: PE-QP-999-507-E001, **R0**			SPECIFICATION TITLE:			TECH. SPEC. FOR HT XLPE POWER CABLES
	SHEET 1 OF 9		SYSTEM			ITEM : HT XLPE Power Cables			SECTION			VOLUME III
SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
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												
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 Rods (Conductor/ Armour Wire)**	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample/ Batch	IS:7098-II,IS: 5082, IS:5484, IS:8130 & Appd Datasheet	IS:7098-II,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-	IS 8130, IS 5082/ Approved datasheet	IS 8130, IS 5082/ 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-II & Mfs Std./ Approved datasheet	IS 7098-II & 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

BHEL	**STANDARD QUALITY PLAN**		CUSTOMER : NTPC-SAIL POWER COMPANY (P) LIMITED			PROJECT TITLE: 1 X 250 MW ROURKELA PP-II EXPANSION PROJECT			SPECIFICATION NUMBER:			PE-TS-427-507-E001
			BIDDER/ VENDOR:			QUALITY PLAN NUMBER: PE-QP-999-507-E001, **R0**			SPECIFICATION TITLE:			TECH. SPEC. FOR HT XLPE POWER CABLES
	SHEET 2 OF 9		SYSTEM			ITEM : HT XLPE Power Cables			SECTION			VOLUME III

SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.3	**Semi Conducting Compound**	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample/ Batch	IS 7098-II & Mfs Std./ Approved datasheet	IS 7098-II & Mfs Std./ Approved datasheet	Inpection Report/ Test Cert.	2/3	-	1/2	
		SPECIFIC CHECKS :										
		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	
		3. Shelf life/ Storage condition	MA	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	2/3	-	1	
1.4	**Copper Tape**	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample/ Batch	IS 7098-II, IS 1897, IS 613 & Mfr. Std./ Approved datasheet	IS 7098-II, IS 1897, IS 613 & Mfr. Std./ Approved datasheet	Inpection Report/ Test Cert.	2/3	-	1/2	
		2. Elec.Properties	MA	Electrical Tests	Sample/ Batch	-do-	-do-	-do-	2/3	-	1/2	
		3. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	2/3	-	2	
		SPECIFIC CHECKS :										
		1. Resistivity	MA	Electrical Tests	Manufacturer std.	IS 613	IS 613	-do-	3/2	-	1	
1.5	**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)
1.6	**PVC Compound (for sheath)**	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample/ Batch	IS 7098-II, IS 5831& Mfr. Std./ Approved datasheet	IS 7098-II, IS 5831& Mfr. Std./ Approved datasheet	Inpection 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	

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

	STANDARD QUALITY PLAN		CUSTOMER : NTPC-SAIL POWER COMPANY (P) LIMITED			PROJECT TITLE: 1 X 250 MW ROURKELA PP-II EXPANSION PROJECT			SPECIFICATION NUMBER:			PE-TS-427-507-E001
			BIDDER/ VENDOR:			QUALITY PLAN NUMBER: PE-QP-999-507-E001, **R0**			SPECIFICATION TITLE:			TECH. SPEC. FOR HT XLPE POWER CABLES
	SHEET 3 OF 9		SYSTEM			ITEM : HT XLPE Power Cables			SECTION			VOLUME III
SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		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	
1.7	**Galvanised steel wire/strip for Armour (as applicable)**	**GENERAL :**										
		1. Make	MA	Verify	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Inpection Report/ Test Cert.	2/3	-	1	
		2. Dimension	MA	Measurement	-do-	IS 7098-II, IS 3975 & Approved datasheet	IS 7098-II, IS 3975 & Approved datasheet	-do-	2/3	-	2	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	-do-	-do-	-do-	2/3	-	2	* Sample from each armour size/ Batch / Lot
		4.Galvanization Quality	MA	Galv.Tests	-do-	IS 3975 & Mfr. Std.	IS 3975 & Mfr. Std.	-do-	2/3	-	2	
1.8	**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	
		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

BHEL	**STANDARD QUALITY PLAN**		CUSTOMER : NTPC-SAIL POWER COMPANY (P) LIMITED			PROJECT TITLE: 1 X 250 MW ROURKELA PP-II EXPANSION PROJECT			SPECIFICATION NUMBER:			PE-TS-427-507-E001
			BIDDER/ VENDOR:			QUALITY PLAN NUMBER: PE-QP-999-507-E001, **R0**			SPECIFICATION TITLE:			TECH. SPEC. FOR HT XLPE POWER CABLES
	SHEET 4 OF 9		SYSTEM			ITEM : HT XLPE Power Cables			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
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	
		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/	IS 8130 & Appd. Datasheet	IS 8130 & Appd. Datasheet	-do-	2	-	-	
2.3	**Conductor Screening**	1. Surface Finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inpection Report	2	-	-	
		2. Radial Thickness	CR	Mechanical	One Sample of each size/	IS 7098-II & Appd. Datasheet	IS 7098-II & Appd. Datasheet	-do-	2	-	-	
2.4	**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-II & Appd. Datasheet	IS 7098-II & Appd. Datasheet	-do-	2	-	1	*# To be checked at starting & finished end of extruded length.*
		3. Insulation Thickness	CR	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		4. Dia over insulation	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		5. Tensile Strength & % Elongatio	MA	Mechanical	100%	-do-	-do-	-do-	2	-	-	

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

	STANDARD QUALITY PLAN	CUSTOMER : NTPC-SAIL POWER COMPANY (P) LIMITED	PROJECT TITLE: 1 X 250 MW ROURKELA PP-II EXPANSION PROJECT	SPECIFICATION NUMBER: PE-TS-427-507-E001
		BIDDER/ VENDOR:	QUALITY PLAN NUMBER: PE-QP-999-507-E001, **R0**	SPECIFICATION TITLE: TECH. SPEC. FOR HT XLPE POWER CABLES
	SHEET 5 OF 9	SYSTEM	ITEM : HT XLPE Power Cables	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.5	**Insulation Screening**	**NON METTALIC**										
		1. Surface finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inpection Report	2	-	-	
		2. Thickness	CR	Measurement	One Sample of each size/ lot	IS 7098-II & Appd. Datasheet	IS 7098-II & Appd. Datasheet	-do-	2	-	-	
		METALLIC										
		1. Dimension of tape	CR	Measurement	One Sample of each size/	Mfrs Std. / Appd. datasheet	Mfrs Std. / Appd. datasheet	Inpection Report	2	-	-	
		2. Overlap of Tape Band	MA	-do-	-do-	-do-	-do-	-do-	2	-	-	
		3. Tightness of Tape	MA	Visual	-do-	Mfs Std.	Mfs Std.	-do-	2	-	-	
2.6	**Core Laying**	1. Dia over laid up core	MA	Measurement	One Sample of each size/	IS 7098-II & Appd. Datasheet	IS 7098-II & Appd. Datasheet	Inpection Report	2	-	-	
		2. Sequence of lay & direction	MA	Visual & Meas.	-do-	IS 7098-II & Mfr. Std.	IS 7098-II & Mfr. Std.	-do-	2	-	-	
		3. Lay Length	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
2.7	**InnerSheath Extrusion (as applicable)**	1. Surface finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inpection Report	2	-	-	*(Pimple, fish eye, porosity & burnt particles not permitted.)*
		2. Thickness	CR	Measurement	One Sample of each size/	IS 7098-II & Appd. Datasheet	IS 7098-II & Appd. Datasheet	-do-	2	-	-	
		3. Dia over inner sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-	
2.8	**Armour(as applicable)**	1. No.of wires/Strips	MA	Counting	At the start of the process	IS 7098-II & Appd. Datasheet	IS 7098-II & Appd. Datasheet	Inpection Report	2	-	-	
		2. Lay length & Direction	MA	Visual & Meas.	-do-	IS 7098-II & Mfr. Std.	IS 7098-II & Mfr. Std.	-do-	2	-	-	
		3. Dia over armouring	MA	Measurement	-do-	IS 7098-II & Appd. Datasheet	IS 7098-II & Appd. Datasheet	-do-	2	-	-	
		4. Coverage	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	

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

	STANDARD QUALITY PLAN		CUSTOMER : NTPC-SAIL POWER COMPANY (P) LIMITED			PROJECT TITLE: 1 X 250 MW ROURKELA PP-II EXPANSION PROJECT			SPECIFICATION NUMBER:			PE-TS-427-507-E001
			BIDDER/ VENDOR:			QUALITY PLAN NUMBER: PE-QP-999-507-E001, **R0**			SPECIFICATION TITLE:			TECH. SPEC. FOR HT XLPE POWER CABLES
	SHEET 6 OF 9		SYSTEM			ITEM : HT XLPE Power Cables			SECTION			VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
2.9	**Outer Sheath Extrusion (No repair permitted)**	1. Surface finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inpection Report	2	-	-	*(Pimple, fish eye, porosity & burnt particles not permitted.)*
		2. Sheath Thickness	CR	Measurement	One Sample of each size/ lot	IS 7098-II & Appd. Datasheet	IS 7098-II & Appd. Datasheet	-do-	2	-	-	
		3. Dia over outer sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-	
		4. Embossing/ Sequencial Marking	MA	Visual	100%	Approved data sheet	Approved data sheet	-do-	2	-	-	
3.0	**Finished Cable (INTERNAL)**	**1. Routine Test (Refer Note-F)**	CR	Electrical Tests & Measurement	100%	IS 7098-II & Appd. Datasheet	IS 7098-II & Appd. Datasheet	Test Report	2	-	1	
4.0	**Final Inspection (EXTERNAL)**	**1. Finish**	MA	Visual	One drum in each Lot	IS 7098-II & Appd. Datasheet	Free from Porosity, Bulging, Burnt particles,lumps, cuts &	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	-	

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

	STANDARD QUALITY PLAN	CUSTOMER : NTPC-SAIL POWER COMPANY (P) LIMITED	PROJECT TITLE: 1 X 250 MW ROURKELA PP-II EXPANSION PROJECT	SPECIFICATION NUMBER: PE-TS-427-507-E001
		BIDDER/ VENDOR:	QUALITY PLAN NUMBER: PE-QP-999-507-E001, **R0**	SPECIFICATION TITLE: TECH. SPEC. FOR HT XLPE POWER CABLES
	SHEET 7 OF 9	SYSTEM	ITEM : HT XLPE Power Cables	SECTION VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		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	-	*# Refer Annexure to QAP enclsoed*
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 / BHEL SPECIFICATION, 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 TO QAP ENCLOSED.***

LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL 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

TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS

A. Type Test Conduction:

1. Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.

2. Sampling:
   a) Type test to be conducted on one size of each voltage grade per lot.
   b) FRLS test & Electrical tests to be conducted on every size & voltage grade of cables.
   c) Flammability Test to be conducted only on one sample/ lot/voltage grade.

B. Acceptance Test Conduction:

1. Tests for which "A" is indicated in the 'Test Conduction Required As' column below shall be conducted as Acceptance tests.

2. Sampling:
   a) Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 7098 Part 2.
   b) Flammability Test to be conducted only on one sample taken from each offered lot of all sizes.

C. Routine Test Conduction:

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

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	Tests for Conductor				
I.	Resistance test	For Al	T, A, R	IS 10810 Pt 5	
2.0	Physical Tests for XLPE Insulation & PVC sheath				
I.	Test for thickness & Eccentricity	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	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	For PVC outer sheath only	T	IS 10810 Pt 10	
V.	Hot deformation test	For PVC outer sheath only	T	IS 10810 Pt 15	
VI.	Heat shock test	For PVC outer sheath only	T	IS 10810 Pt 14	
VII.	Shrinkage test	For XLPE insulation & PVC outer sheath only	T	IS 10810 Pt 12	

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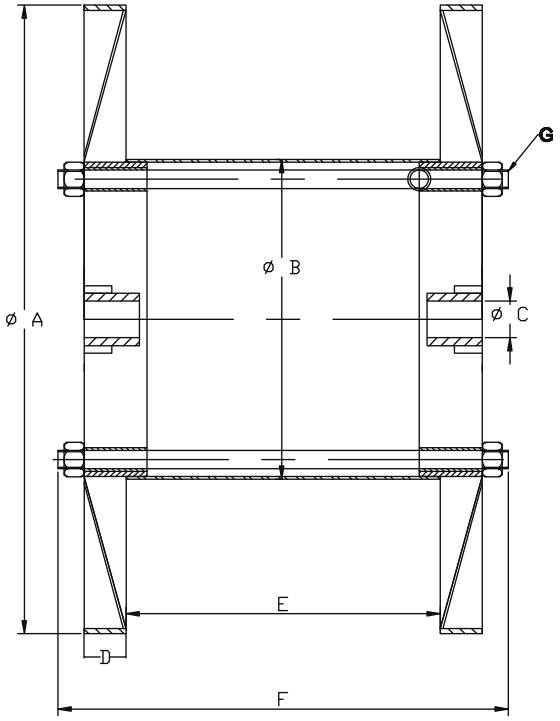
	DATE		BIDDER'S / VENDORS COMPANY SEAL

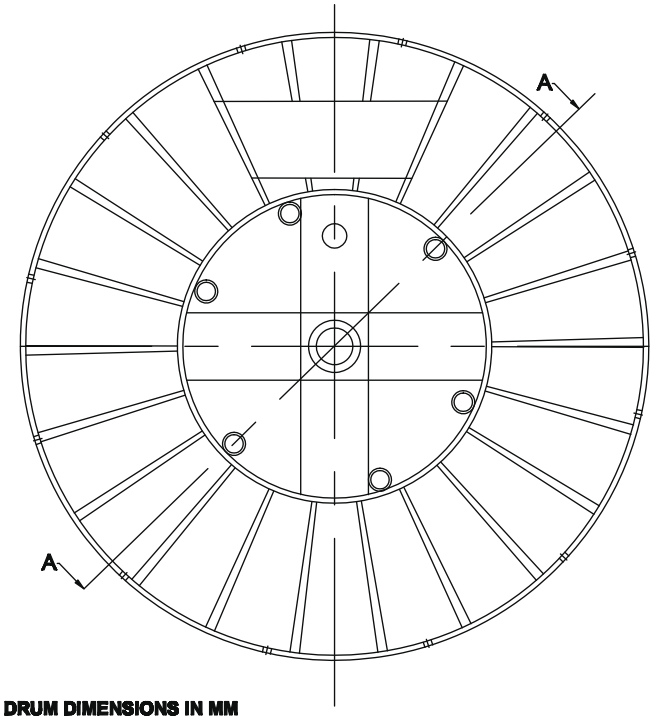
S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
VIII.	Thermal stability test	For PVC outer sheath only	T	IS 10810 Pt 60	
IX.	Hot set test	For XLPE insulation only	T, A	IS 10810 Pt 30	
X.	Water absorption (gravimetric) test	For XLPE insulation only	T	IS 10810 Pt 33	
XI.	Degree of cross-linking	For XLPE insulation only	T	IS 7098-II	
3.0	Tests On Extruded Semi-conducting Screen				
I.	Test for cross linking		A	IS 7098-II	
4.0	Improved Fire performance (FR-LSH) Tests				
I.	Oxygen index test	For outer sheath only	T, A	IS 10810 Pt 58 / ASTMD 2863	
II.	Smoke density test	For outer sheath only	T, A	ASTMD 2843	
III.	Acid gas generation test	For outer sheath only	T, A	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	For outer sheath only	T	IS 10810 Pt 64 / ASTMD 2863	
5.0	Flammability Tests				
I.	Flammability test for bunched cables	For complete cable	T,A	IS 10810 Pt 62/ IEC-60332 (Part-3) Cat-B	
II.	Flammability test for single cable	For complete cable	T,A	IS: 10810 Pt 61 / IEC:60332 Part-1	
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	
III.	Partial discharge test (shall be carried out on full drum length)		T,A,R	IS 10810 Pt 46	
IV.	Bending Test followed by Partial Discharge test		T	IS 10810 Pt 50	
V.	Dielectric Power Factor Test (i) As a function of voltage (ii) As a function of temperature		T	IS 10810 Pt 48	
VI.	Heat Cycle Test		T	IS 10810 Pt 49	
VII.	Impulse Withstand Test		T	IS 10810 Pt 47	
VIII.	Thermal ageing test	For complete cable	T	IS 7098-II	
IX.	Flammability Test	For PVC sheathed cable	T	IS 10810 Pt 53	

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

STEEL DRUM DRAWING (TYPICAL)

ANNEXURE-B TO SECTION-II





APPROXIMATE DRUM DIMENSIONS IN MM

ALL DIMENSIONS AND VALUES ARE TYPICAL AND ARE DEPENDENT ON CABLE WEIGHT.

A	FLANGE	2200
B	BARREL	1200
C	CENTRAL HOLE	100
D	FLANGE	50
E	TRAVERSE	1400
F	GROSS WIDTH	1600
G	STUD SIZE	16 MM.

- Drg. not to scale.
- ALL DIMENSIONS ARE IN MM.

ANNEXURE-C

QUALITY ASSURANCE & INSPECTION

MODULE NO. SQE 13

H.T CABLES

Item / Components / Sub System Assembly / Attributes / Characteristics	Make, Type, Rating & T.C	Dimension/surface finish	Mechanial properties	Chemical Composition	Spark Test(as applicable)	Curing Properties	Electrical properties	Hot Set Test/ Eccentricity & Ovality	Lay length & Sequence	Armour coverage, cross over, looseness, gap between two wire	Sequential marking/surface finish/ cable length	T.S & elongation before & after ageing on outer sheath & insulation	Thermal seability on outer sheath	Metallic (Cu) Screening (If applicable)	Anti termite coating on wooden drums	Constructional requirements feature as per NSPCL specification	Routine & Acceptance Test as per relevant standard & NSPCL	FRLS Test
Aluminium (IS-8130)	Y	Y	Y	Y			Y											
Semiconducting Compound	Y		Y			Y	Y											
XLPE Compound (IS-7098 Part-II)	Y		Y			Y	Y					Y						
FRLS PVC Compound (IS-5831, ASTM-D2843, IS10810(Part 58) ,IEC-60754 Part-1)	Y		Y									Y	Y					Y
Triple Extrusion & curing /Manufacturing of Core		Y			Y			Y	Y									
Copper Tape	Y	Y	Y				Y											
Polyster tape	Y	Y																
Armour wire/strip	Y	Y	Y															
Copper tapping	Y	Y					Y											
Inner sheath	Y	Y																
Armouring										Y				Y				
Outer Sheathing		Y									Y	Y	Y			Y		Y
Power Cable (Finished) (IS : 7098 Part II, IEC : 60332 (Part 3 Cat. B), IS-5831, ASTM-D2843, IS10810(Part 58) , IEC-60754 Part-1)	Y								Y	Y	Y	Y	Y			Y	Y	Y
Wooden drum(IS-10418) /Steel Drum		Y													Y			

Notes:
1. This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
2. Make of all major Bought Out Items will be subject to NSPCL approval.

QUALITY ASSURANCE & INSPECTION

ROUTINE TESTS

Routine tests shall be carried out on each drum of finished cables for all types & sizes.
Following shall constitute routine tests:

1) Conductor Resistance test

2) High voltage test

3) Partial discharge test **(for Screened cables only)**

ACCEPTANCE TESTS

Following Acceptance tests shall be carried out for each type and size of the cables on the cable drums selected at random as per sampling plan mentioned in IS: 7098 Part 1I

A) For Conductor
1) Tensile Test
2) Wrapping Test
3) Resistance test

B) For Armour Wires / Formed Wires (If applicable)

1)	Measurement of Dimensions	
2)	Tensile Tests	
3)	Elongation Test	
4)	Torsion Test	For Round wires only
5)	Wrapping Test	
6)	Resistance Test	
7)	Mass of Zinc coating test	For G S wires / Formed wires only
8)	Uniformity of Zinc coating	For G S wires / Formed wires only
9)	Adhesion test	For G S wires / Formed wires only
10)	Freedom from defects	

C) For XLPE insulation & PVC Sheath
1) Test for thickness
2) Tensile strength & Elongation before ageing
3) **Hot set test** **(For XLPE insulation)**

D) For completed cables
1) Insulation resistance test (Volume resistivity method)
2) High voltage test
3 Partial discharge test **(for Screened cables only)**

QUALITY ASSURANCE & INSPECTION

E) **Following tests shall be carried out and only one sample shall be taken from each offered lot of all sizes for these tests:-**

1) Thermal stability test **on PVC insulation and outer sheath**

2) Oxygen index test **on outer sheath**

3) Smoke density rating test **on outer sheath as per ASTM –D 2843**

4) Acid gas generation test **on outer sheath as per IEC –60 754 (Part 1)**

5) Flammability test **as per IEC 60332 - Part- 3 (Category- B) on completed cable**

F) **Ageing test on XLPE insulation and PVC outer sheath as per following:**

In case of regular manufacturers:-
Samples as per relevant IS from every size & type of cable in the offered lot shall be tested for tensile strength & elongation (before ageing). The values will be compared with corresponding values mentioned in the type test report accepted by NSPCL.
In case values of tensile strength & elongation (before ageing) of PVC insulation & outer sheath are within + /- 15% of the type test reports then 1 sample from sizes which meet the criteria will be put on accelerated ageing test. The accelerated ageing test procedure for PVC insulation & outer sheath: sample to be put in air oven at temperature of 130^c +/- 2^c for 5 hours, tensile strength & elongation acceptance norms as per relevant IS.

However in case the tensile strength and elongation values are not within +/- 15% of type test values then 1 sample of that particular size of cable will be tested for tensile strength & elongation after ageing test as per relevant IS.

For XLPE insulation: 1 sample of every size will be put on ageing test as per relevant IS.

In case of new manufacturers / suppliers (supplying first time to NSPCL through corporate contract):-

Samples as per relevant IS from every size & type of cable in the offered lot shall be tested for tensile strength & elongation (before ageing). 1 Samples from every size & type of cable in the offered lot shall be tested for tensile strength & elongation after ageing test as per IS.

G) **Following tests shall be carried on one length of each size of offered lot:**

1) Surface finish, length measurement, sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires

2) Measurement of Eccentricity & Ovality