VOLUME-II

MAHARASTRA STATE POWER GENERATION CO. LTD.

1X660MW BHUSAWAL TPS UNIT#6

TECHNICAL SPECIFICATION

FOR

LT XLPE POWER CABLE

SPECIFICATION NO: ***PE-TS-415-507-E002***

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 is 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 specification shall prevail).

BIDDER'S STAMP & SIGNATURE

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

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 Cable conforming to this specification.

1.2 It is not the intent to specify herein all the details of design & manufacture of material. However, the material shall conform in all respects to high standard of design, engineering & workmanship and shall be capable of performing in continuous commercial operation at site condition.

1.3 General technical requirements of the LT XLPE Power cables are indicated in Section-II & Datasheet-A. Project specific technical/ quality requirements / changes are listed in Section-I.

1.4 The stipulation of Data Sheet-A shall prevail in case of any conflict between the stipulations of Data Sheet-A & Section-II.

1.5 The documents shall be in English Language and MKS system of units.

2.0 BILL OF QUANTITIES

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

3.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

3.1 After placement of order, documents shall be submitted for BHEL & customer's approval as specified in NIT.

3.2 Drawings/documents shall be submitted through Document Management System (DMS).

DATA SHEET-A

1.0	Type of Cable	Flame Retardant Low Smoke halogen (FR-LSH)	
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	1.0 sec	
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/ Shaped – as per IS	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)	Nominal Thickness of insulation	As per IS: 7098 (Part-1)	
8.0	CORE IDENTIFICATION	By colour coding as per IS: 7098 - Part -1	
9.0	INNER SHEATH		
(a)	Material	Extruded HRPVC Type ST-2	
(b)	Standard Applicable	IS: 7098 (Part-1) & IS: 5831	
(c)	Colour	Black	
(d)	Whether FR-LSH	Yes	
(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 Wire H4 grade to IS: 8130 (as specified in BOQ cum price schedule)
(ii)	Multi-core cables	Galvanised Steel Round Wire conforming to IS 7098 Part-I (as specified in BOQ cum price schedule)
(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
11.0	OUTERSHEATH	
(a)	Material	HRPVC 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-8 of IS: 7098 (Part-1)
(f)	Marking	Cable size (cross section area and no. of cores), voltage grade and Reference IS @ 1m (by embossing) Word "XLPE", "FR-LSH" @ 1m (by embossing) Manufacturer's name and/ or trade mark, year of manufacture @ 1m (by embossing) 'BHEL-PEM' and 'MAHAGENCO' name @ 1m (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 29 (As per IS 7098-I /ASTMD 2863)
(b)	Temperature index	Min. 250^{o}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)
(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
15.0	TOLERANCE ON OUTER DIAMETER	± 2mm
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 (if applicable)	50 N/ sq. mm
18.0	CABLE DRUMS	
(a)	Type of Drum	Wooden (heavy construction) as per IS 10418
(b)	Standard drum length	500m (±) 5% / 1000m (±) 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	*Clause no 4.2 of Section-II of this technical specification*
(f)	Particular details on Drum	*Clause no 4.3 of Section-II of this technical specification* *Further customer specific marking requirement (if any) shall be informed later.*
(g)	Cable packing	Please refer Clause no 4.2 of Section-II of this technical specification. It may be noted that the outer most cable layer shall be covered with water proof cover polythene followed by complete drum covering with wooden plank of suitable thickness across flanges. (Refer typical drawing of cable drum packing, attached in section -II)
19.0	Sea Worthy packing	No

DATASHEET C

GUARANTEED TECHNICAL PARTICULARS
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

S.No.		Unit	Description
A	**GENERAL**	-	
1	Name of manufacturer	-	
2	Place of Manufacture	-	
3	Current rating of cables conforms to	-	
4	Short circuit rating conforms to	-	
5	Formula for calculating short circuit current for different duration	-	
6	Permissible conductor temperature		
	(a) Maximum continuous rating	deg. C	
	(b) Short circuit rating	deg. C	
7	(a) Installation Conditions at site		
	i) Ambient air temperature	deg. C	
	ii) Ground temperature	deg. C	
	iii) Depth of laying of cables buried in ground	cm	
8	CHARACTERISTICS OF FRLS SHEATH		
	(a) Oxygen index	%	
	(b) Temperature index	deg. C	
	(c) Acid gas generation	%	
	(d) Smoke density rating	%	
9	CABLE DRUMS		
	(a) Type & construction	-	
	(b) Standard drum length	Mtr	
	(c) Tolerance on drum length	%	
B	**INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE**		
1	No. of cores x size	No. x sq.mm	
2	Voltage grade (Uo/U)	kV	
3	Base current ratings (*) based on Sl. (A) 7.0		
	(a) In air	Amp	
	(b) In ground	Amp	
	(c) ducts	Amp	

4	Short circuit rating for 1 sec duration	kA	
5	(a) D.C. resistance of conductor at 20 deg C (main / neutral)	ohm/km	
	(b) A.C. resistance of conductor at 90 deg. C (main / neutral)	ohm/km	
	(c) Reactance of cable at Normal frequency	ohm/km	
	(d) Electrostatic capacitance of cable at normal frequency	µF/km	
6	CONDUCTOR		
	(a) Material type	-	
	(b) Grade	-	
	(c) No & dia of wires in each core before stranding	no x mm	
	(d) Shape	-	
7	INSULATION		
	(a) Material	-	
	(b) Nominal thickness (main / neutral)	mm	
	(c) Minimum thickness (main / neutral)	mm	
	(d) Minimum volume resistivity at 27 deg. C	Ohm-cm	
	(e) Minimum volume resistivity at 90 deg. C	Ohm-cm	
8	INNERSHEATH		
	(a) Material	-	
	(b) Whether FRLS	-	
	(c) Thickness (min.)	mm	
	(d) Method of application for multi-core cables	-	
	(e) Type and shape of fillers (if used)	-	
	(f) Colour	-	
9	ARMOUR		
	(a) Material	-	
	(b) Type of armour	-	
	(c) Size/ dimensions (Nominal dia of wire)	mm	
	(d) Minimum no. of round / formed wires	No.	
	(e) Minimum coverage	%	
	(f) Gap between armour wire/strip	-	
	(g) Breaking load of joint	-	
	(h) Maximum resistivity of GS formed / Round wire	Ohm-cm	
	(i) Maximum resistivity of Aluminium round wire	Ohm-cm	
10	OUTERSHEATH		
	(a) Material	-	
	(b) Whether FRLS	-	
	(c) Minimum thickness	mm	

	(d) Colour	-	
	(e) Method of application	-	
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	
	(e) Tolerance on overall diameter	(±) mm	
12	Ovality	mm	
13	Minimum bending radius	x O.D	
14	Safe Pulling Force	N/mm^2	
15	Weight of cable	kg./km	
16	Dimension of drum	mm	
17	Shipping weight (approx.)	kg	
18	Cable marking on outer sheath	-	
19	Marking on drum	-	

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

SECTION-II

STANDARD TECHNICAL REQUIREMENTS

1.0 CODES AND STANDARDS

1.1 The material shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the material is to be installed.

1.2 The design, material, construction, manufacture, inspection and testing of LT XLPE POWER Cable shall conform to the latest revision of relevant standards as per Data Sheet-A.

1.3 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

2.0 TECHNICAL REQUIREMENTS

2.1 LT XLPE POWER Cable shall be supplied as per technical particulars specified in Data Sheet – A.

3.0 QUALITY ASSURANCE, TESTING & INSPECTION

3.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E002, Rev-02) as attached with the specification without any deviations. At contract stage (project specific), 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, routine / acceptance testing and special testing requirements shall be as per Annexure –A to QAP. Charges for all these tests for all the equipments & 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 wooden.

4.2 For wooden drums, all wooden parts shall be manufactured from seasoned wood treated with copper napthenates / zinc napthenates (refer IS: 401) and anti-termite. 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. 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.

4.3 Each drum shall carry manufacturer's name, purchaser'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.

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 1 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	**RAW MATERIALS**													
1.1	**Aluminium /Copper Rods**	**GENERAL :**												
	(Conductor/ Armour Wire)	1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample / Batch	IS:8130 (Al), IS:613 (Cu)	IS:8130 (Al), IS:613 (Cu)	Test Cert.	✓	P/ V	V	-	
		2. Elec. Properties	MA	Electrical Tests	Sample/ Batch	Sample / Batch	-do-	-do-	-do-	✓	P/ V	V	-	
		SPECIFIC CHECKS:												
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	-	
		b) Grade	MA	-do-	-do-	-do-	IS:8130 (Al), IS:613 (Cu)	IS:8130 (Al), IS:613 (Cu)	-do-	✓	P	V	-	
		c) Resistivity	MA	Electrical Tests	Manufacturer std.	Manufacturer std.	IS:613 (Cu), IS:5082 (Al)	IS:613 (Cu), IS:5082 (Al)	-do-	✓	P	V	-	
1.2	**XLPE Compound for insulation**	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample / Batch	IS 7098-I	IS 7098-I	Test Cert.	✓	P	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/03/20	KUNAL GANDHI		
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/03/2020	RITESH KUMAR JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 2 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		2. Elec. Properties	MA	Electrical Tests	Sample/ Batch	Sample / Batch	-do-	-do-	-do-	✓	P	V	-	
		SPECIFIC CHECKS:												
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P/ V	V	-	
		b) Type/ Grade	MA	-do-	-do-	-do-	-do-	-do-	-do-	✓	P/ V	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	-do-	-do-	-do-	✓	P/ V	V	-	
1.3	**PVC Compound (for sheath)**	**GENERAL:**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample / Batch	IS 5831	IS 5831	Test Cert.	✓	P/ V	V	-	
		2. Elec. Properties	MA	Electrical Tests	Sample/ Batch	Sample / Batch	-do-	-do-	-do-	✓	P/ V	V	-	
		3. FRLS Properties (as applicable)	CR	Chemical/ Environ.	Sample/ Batch	Sample / Batch	Approved datasheet	Approved datasheet	-do-	✓	P/ V	V	-	
		SPECIFIC CHECKS:												

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI		
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 3 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6				*		**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	-	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P	V	-	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	✓	P	V	-	
1.4	**Fillers (as applicable)**	1. Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	-	Fillers material chosen shall be compatible with the temperature rating of the cable and shall have no deleterious effect on any other

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI		
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 4 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6				*		**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
														component of cable)
		2. Type/ Grade	MA	-do-	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-	✓	P/ V	V	-	
1.5	**Galvanised steel wire/strip for Armour (as applicable)**	**GENERAL:**												
		1. Make	MA	Verify	Manufacturer std.	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	-	
		2. Dimension	MA	Measurement	-do-	-do-	Appd. Data Sheet	Appd. Data Sheet	-do-		P/ V	-	-	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	Sample*	-do-	-do-	-do-	✓	P/ V	V	-	
		4.Galvanization Quality	MA	Galv.Tests	-do-	-do-	IS 3975	IS 3975	-do-		P/ V	-	-	
1.6	**Wooden Drum**	1. Phy. & Constructional checks	MA		Mfr's Plant Std.	Mfr's Plant Std.	IS 10418	IS 10418	Test Cert.	✓	P	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	Vikas 18.03.2020	VIKAS KUMAR SINGH	Checked by:	Kunal Gandhi 19/3/20	KUNAL GANDHI		
Reviewed by:	Manish 18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL		

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 5 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		2. Anti termite treatment	MA	Chem.	Mfr's Plant Std.	Mfr's Plant Std.	Mfr's Plant Std.	Mfr's Plant Std.	-do-	✓	P	V	-	
1.7	**Steel Drum #**	1. Dimension	MA	Meas.	Mfr's Plant Std.	Mfr's Plant Std.	Approved drg	Approved drg	Test Cert.	✓	P	V	-	# If required, as per spec.
		2. Surface finish	MA	Visual	-do-	-do-	-	Surface shall be smooth	-do-	✓	P	V	-	
2.0	**IN PROCESS**													
2.1	Wire Drawing	1. Size	MA	Dimensional	Plant Mfg. Std.	Plant Mfg. Std.	Approved datasheet	Approved datasheet	Inspection Report/ Test report	✓	P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	Surface shall be smooth	Surface shall be smooth	-do-	✓	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI
Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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Doc No:			
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Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 6 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3. % of Elongation	MA	Mechanical	-do-	-do-	IS 8130	IS 8130	-do-	✓	P	V	-	
2.2	**Stranding of wires**	1. No. of wires	MA	Counting	Plant Mfg. Std.	Plant Mfg. Std.	Appd. Datasheet	Appd. Datasheet	Inspection Report/ Test report	✓	P	V	-	
		2. Resistance	CR	Electrical	-do-	-	-do-	-do-	-do-	-do-	P	-	-	
		3. Sequence, lay length & Direction	MA	Visual, Meas.	One Sample of each size/ lot	-	Mfrs Std.	Mfrs Std.	-do-		P	-	-	
		4. Surface Finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	-do-		P	-	-	
		5. Dimension	MA	Measurement	One Sample of each size/ lot	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
2.3	**Core Insulation (XLPE)** (No repair permitted)													

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	18.03.2020	VIKAS KUMAR SINGH	Checked by:	19/3/20	KUNAL GANDHI		
Reviewed by:	Manish 18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL		

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	Sign & Date	Name	Seal
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Approved by:			

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	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 7 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6				*		**			
					M	C/N				D	M	C	N	
1	2	3	4	5			7	8	9					
		1. Surface finish	MA	Visual	100%	100%	Free from bulging, burnt particles, lumps, cuts & scratches	Free from bulging, burnt particles, lumps, cuts & scratches	Inspection Report/ Test report	✓	P	V	-	
		2. Eccentricity & Ovality #	CR	Measurement	One Sample of each size/ lot	One Sample of each size/ lot	Mnfr's Std	Mnfr's Std	-do-	✓	P	V	-	
		3. Insulation Thickness	CR	Measurement	-do-	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
		4. Dia over insulation	MA	Measurement	-do-	-	-do-	-do-	-do-		P	-	-	
		5. Tensile Strength & % Elongation	MA	Mechanical	100%	-	IS:1554-I, IS:5831	IS:1554-I, IS:5831	-do-		P	-	-	
		6. Spark Test or Water immersion test	CR	Electrical	100%	-	Mnfr's Std	Mnfr's Std	-do-	Mnfr's Std	P	-	-	
2.4	**Core Laying**	1. Dia over laid up core	MA	Measurement	One Sample of each size/ lot	-	Appd. Datasheet	Appd. Datasheet	Inspection Report/ Test report		P	-	-	

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Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL		

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
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	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 8 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		2. Sequence of lay & direction	MA	Visual & Meas.	-do-	-	IS 7098-I & Mfr. Std.	IS 7098-I & Mfr. Std.	-do-		P	-	-	
						-								
2.5	**Inner Sheath Extrusion (as applicable)**	1. Surface finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	Inspection Report/ Test report		P	-	-	
		2. Thickness	CR	Measurement	One Sample of each size/ lot	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
		3. Dia over inner sheath	MA	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
2.6	**Armour(as applicable)**	1. No.of wires/Strips	MA	Counting	At the start of the process	-	Mnfr's Std	Mnfr's Std	Inspection Report/ Test report		P	-	-	
		2. Lay length / Direction	MA	Visual & Meas.	-do-	-	Mfr. Std.	Mfr. Std.	-do-		P	-	-	
		3. Dia over armouring	MA	Measurement	-do-	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	

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Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E002, REV 02.	
	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 9 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4. Coverage	MA	Measurement	-do-	-	-do-	-do-	-do-		P	-	-	
2.7	**Outer Sheath Extrusion (No repair permitted)**	1. Surface finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	Inspection Report/ Test report		P	-	-	
		2. Sheath Thickness	CR	Measurement	One Sample of each size/ lot	-	Appd. Datasheet	Appd. Datasheet	-do-		P	-	-	
		3. Dia over outer sheath	MA	-do-	-do-	-	-do-	-do-	-do-		P	-	-	
		4. Embossing/ Sequencial Marking	MA	Visual	100%	-	Approved data sheet	Approved data sheet	-do-		P	-	-	
3.0	**Final Inspection (INTERNAL)**	**1. Routine Test (Refer Note-H)**	CR	Electrical Tests & Measurement	100%	100%	#	#	-do-	✓	P	V	V	#: Refer Annexure-A to QP

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Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL

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	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 10 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6				*		**			
					M	C/N				D	M	C	N	
1	2	3	4	5			7	8	9					
4.0	**Final Inspection (EXTERNAL)**	**1. Finish & Length (Cable & cable drum)**	MA	Visual	One drum in each Lot	One drum in each Lot	Appd. Datasheet	Free from Porosity, Bulging, Burnt particles, lumps, cuts & scratches	Inspection Report/ Test report	✓	P	W	W	
		2. Dimension	MA	-do-	IS 7098-I	IS 7098-I	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	W	W	
		3. Armouring - Coverage & No.of Wires/Strips	MA	Visual & Meas.	-do-	-do-	-do-	-do-	-do-	✓	P	W	W	
		4. Marking & Colour Coding	MA	Visual	-do-	-do-	-do-	-do-	-do-	✓	P	W	W	
		5. Acceptance Tests (Refer Note-H)	CR	Phy, Elect. Tests & FRLS Tests	Sample #	Sample #	#	-do-	-do-	✓	P	W	W	
		6. Type Tests (Refer Note-H)	CR	Physical & Electrical Tests	Sample #	Sample #	-do-	-do-	-do-	✓	P	W	W	

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Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL

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	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 11 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					6				*		**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
5.0	**Packing**	**End sealing / Polythene wrapping**	MA	Visual	100%	100%	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	W		

NOTES:

A. Joints in conductors & armour shall be as permitted by IS:8130 & IS:7098-I respectively.
B. No repair of core insulation permitted.
C. Cable ends shall be sealed.
D. Record of raw material, process & all stages shall be certified by Vendors QC and are liable to audit check by purchaser.
E. Fillers/dummy cores etc. Shall be as per BHEL specification.
F. Wherever extent of check for stage is mentioned as 'sample' & not defined in QP, the same shall be as per vendors sampling plan agreed by purchaser.
G. Vendor shall furnish compliance certificate to the inspection agency confirming the packing as per IS/ BHEL specification.
H. For lists of routine tests, acceptance tests & type tests refer annexure to QAP.
I. 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.
J. 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.
K. BHEL reserves the right to perform repeat test, if required.
L. Photographs of cable to be despatched shall be sent to BHEL purchase group for review prior to issue of mdcc.
M. Project specific QP to be prepared in line with this standard QP.
N. In case of export jobs, sea worthy packing as per BHEL technical specification shall be carried out.

LEGENDS:

BHEL					
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Reviewed by:	18/03/20	MANISH SHUKLA	Reviewed by:	19/3/2020	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
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	PROJECT:		PO NO.:	
	ITEM: LT XLPE POWER CABLE	SYSTEM: CABLE	SECTION: II	SHEET 12 OF 12

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	

*RECORDS, IDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,

P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR:** CRITICAL

D: DOCUMENTATION

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ENGINEERING			QUALITY		
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ANNEXURE-A TO QAP

TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS FOR LT XLPE POWER CABLES

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 each type & size of cable on one drum out of every 10 drums for every lot (CU/AL conductor)
   b) Flammability Test to be conducted only on one sample/ lot.

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:
   Acceptance tests to be conducted on one drum out of every 10 drums/ lot for every size & type.

3. Flammability Test to be conducted only on one sample/ lot (Project specific sampling plan shall be informed later)

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.
2. Routine test shall be conducted on 100% drum

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

Note: LOT shall be considered as per IS: 7098 Part-I, appendix-B.

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	***Internal in process Test Report to be furnished for acceptance test***
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	
IV.	Resistance test	For Al/Cu	**T, A, R**	IS 10810 Pt 5	

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
2.0	**Tests for Armour Wires/Strips**				
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 / Adhesion 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	Applicable for Aluminium wire & GS wire	**A**	IS 10810 Pt 3	
3.0	**Physical Tests for XLPE Insulation & PVC sheath**				
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**	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	
VIII.	Thermal stability test	For PVC outer sheath only	**T**	IS 10810 Pt 60	
IX.	Cold Impact test	For PVC outer sheath only	**T**	IS 5831/1984	
X.	Bleeding and Blooming test	For PVC outer sheath only	**T**	IS 5831/1984	
XI.	Hot set test	For XLPE insulation only	**T, A**	IS 10810 Pt 30	
XII.	Water absorption (gravimetric) test	For XLPE insulation only	**T**	IS 10810 Pt 33	
4.0	**Improved Fire performance (FR-LSH) Tests**				

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
I.	Oxygen index test	For PVC outer sheath only	**T, A**	IS 10810 Pt 58 / ASTMD 2863/ NES 715-I	**Applicable for Inner Sheath also, if the same is indicated in Datasheet-A**
II.	Smoke density test	For PVC outer sheath only	**T, A**	IS 10810 Pt 63 / ASTMD 2843	
III.	Acid gas generation test	For PVC outer sheath only	**T, A**	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	For PVC outer sheath only	**T, A**	IS 10810 Pt 64 / ASTMD 2863	
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	**Test & Category applicable as indicated in Datasheet-A**
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	**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**	Refer Note	

Note: A few chipping of the PVC compound is slowly ignited on a porcelain dish or cubicle in a muffle furnace at about 600 degree C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). Place a drop of aqueous sodium sulphide solution on a thick filter paper and allow soaking. Touch the spot with a drop of above extract. A black spot indicates the presence of lead, the anti-termite and rodent compound.

TYPICAL DRAWING OF CABLE DRUM PACKING