TELANGANA STATE POWER GENERATION CORPORATION LIMITED

5X800MW YADADRI TPS

VOLUME -II

TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLE

SPECIFICATION NO: PE-TS-417-507-E001
REVISION: 00

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

	DOCUMENT TITLE	SPECIFICATION NO. PE-TS- 417-507-E001	
BHEL	TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	VOLUME II	
		CONTENT	
		REVISION 0	DATE: 27.04.2022
		SHEET 1 of 1	

CONTENTS

TOTAL NO. OF SHEETS= 36

(INCLUDING COVER/ SEPARATOR SHEETS)

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	SPECIFICATION NO. PE-TS- 417-507-E001	
		VOLUME II	
		COMPLIANCE CERTIFICATE	
		REVISION 0	DATE: 27.04.2022
		SHEET 1 of 1	

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 deviations 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 Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of HT XLPE Power Cables conforming to this specification.

1.2 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.

1.3 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

3.1 TECHNICAL

S.No.	Reference Clause No. of Section- II	Specific Requirement/ Change
1. 3.	5, 3.6, 3.7	The type tests are required to be conducted as indicated in Annexure to QAP and the same shall be offered for inspection (conduction of type tests shall be witnessed by BHEL/Customer). Bidder to indicate unit price of cables inclusive of type test charges. No separate charges shall be payable for type tests.
2.	3.8	Refer S. No. 1 above.

3.2 QUALITY/INSPECTION

S.No.	Reference Clause No. of Section- II	Specific Requirement/ Change
1. 3.	7	All Tests shall be conducted as per contract. Conduction of Testing requirements mentioned in datasheet-A & Annexure to QAP.

3.3 The successful bidder shall submit the standard list of raw material suppliers/ sub-vendors for approval without any commercial implications. Changes to the same, if proposed by any bidder, shall be to BHEL approval.

3.4 Quality Plan applicable for project:
BHEL Standard Quality Plan no. PE-QP-999-507-E001, R1 (Enclosed with specification)

3.5 A label shall be securely attached to each end of the reel indicating the length, type, voltage grade, conductor size and number of core of the cable. Also Weight of cable drum with and without cables and type of end sealing to be indicated. A tag containing the same information shall be attached to the leading end of the cable inside. An arrow and necessary instructions shall be marked on the drum indicating the direction in which it should be rolled.

4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

4.1 Documents/drawings shall be submitted after placement of order for BHEL and customer approval which has been specified in NIT.

NOTE-

1. Vendor shall submit the dates for drawing/document submission/BHEL comments/ resubmission after approval of documents.

2. In BOM each of the item to be uniquely identified with item code no. or item Sl. No. Supplier to ensure that all the items which will find separate mention in the packing list are covered in detailed BOM. Supplier to give following undertaking in BOM : " The BOM provided here completes the scope (in content and intent) of material supply under PO no. ---- dtd ----- Any additional material which may become necessary for the intended application of supplied item/package will be supplied free of cost in most reasonable time."

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

* 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.

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	SPECIFICATION NO. PE-TS-417-507-E001
		VOLUME II
		SECTION I
		REVISION 00 / DATE: 27.04.2022
		SHEET -

QUALITY PLAN

	MANUFACTURING QUALITY PLAN	SPEC No.: PE-TS-417-507 - E001 Rev 00	Date 06.12.2021
	CUSTOMER : TSGENCO	QP NO.: PE-V0-417-507-E912 Rev 02	
	PROJECT: 5X800 MW YADADRI TPS		
	ITEM: HT XLPE CABLES		SHEET 1 OF 12
	1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV 4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV		

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

SUPPLIER QUALITY ASSURANCE			BHEL-PEM QUALITY			FOR CUSTOMER REVIEW & APPROVAL		
	Sign & Date	Name		Sign & Date	Name		Sign & Date	Name
Prepared By:			Reviewed by:	kusum	Kusum Gautam	Approved by:		
Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal			

	MANUFACTURING QUALITY PLAN	SPEC No.: PE-TS-417-507 - E001 Rev 00 QP NO.: PE-V0-417-507-E912 Rev 02	Date 06.12.2021
	CUSTOMER : TSGENCO		
	PROJECT: 5X800 MW YADADRI TPS		SHEET 2 OF 12
	ITEM: HT XLPE CABLES 1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV 4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV		

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					6				*		**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
					Batch	Batch								
		SPECIFIC CHECKS :												
		a) Make	MA	Physical verification	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P/V	V	V	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P/V	V	V	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	-do-	-do-	-do-	✓	P/V	V	V	
1.3	**Semi Conducting Compound & Semi conducting tape (which is easily strippable)**	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	IS 7098-II	IS 7098-II	Inspection Report/ Test Cert.	✓	P	V	V	
		SPECIFIC CHECKS :												
		1. Make	MA	Physical verification	100%	100%	Manufacturer approved source	Manufacturer approved source	-do-	✓	P	V	V	
		2. Type/ Grade	MA	-do-	-do-	-do-	IS 7098-II	IS 7098-II	-do-	✓	P	V	V	
		3. Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	✓	P	V	V	

SUPPLIER			BHEL-PEM			FOR CUSTOMER REVIEW & APPROVAL
QUALITY ASSURANCE			QUALITY			
	Sign & Date	Name		Sign & Date	Name	
Prepared By:			Reviewed by:	kusum	Kusum Gautam	Approved by:
Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal	

	MANUFACTURING QUALITY PLAN	SPEC No.: PE-TS-417-507 - E001 Rev 00 QP NO.: PE-V0-417-507-E912 Rev 02	Date 06.12.2021
	CUSTOMER : TSGENCO		
	PROJECT: 5X800 MW YADADRI TPS		SHEET 3 OF 12
	ITEM: HT XLPE CABLES 1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV 4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV		

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					6				*		**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
1.4	Copper Tape	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	IS 7098-II & Approved datasheet	IS 7098-II & Approved datasheet	Inpection Report/ Test Cert.	✓	P	V	V	
		2. Elec. Properties	MA	Electrical Tests	Sample/ Batch	Sample/ Batch	-do-	-do-	-do-	✓	P	V	V	
		3. Dimension	MA	Measurement	-do-	-do-	-do-	-do-	-do-	✓	P	V	V	
		3. Continuity	MA	Electrical Tests	-do-	-do-	-do-	-do-	-do-	✓	P	V	V	
		SPECIFIC CHECKS :												
		1. Resistivity	MA	Electrical Tests	Sample/ Batch	Sample/ Batch	IS 613	IS 613	-do-	✓	P	V	V	

SUPPLIER QUALITY ASSURANCE			BHEL-PEM QUALITY			FOR CUSTOMER REVIEW & APPROVAL		
	Sign & Date	Name		Sign & Date	Name		Sign & Date	Name
Prepared By:			Reviewed by:	kusum	Kusum Gautam	Approved by:		
Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal			

	MANUFACTURING QUALITY PLAN	SPEC No.: PE-TS-417-507 - E001 Rev 00	Date 06.12.2021
	CUSTOMER : TSGENCO	QP NO.: PE-V0-417-507-E912 Rev 02	
	PROJECT: 5X800 MW YADADRI TPS		SHEET 4 OF 12
	ITEM: HT XLPE CABLES 1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV 4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV		

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					6				*		**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
1.5	Solid Fillers (as applicable)	1. Make	MA	Physical verification	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P/V	V	V	Fillers material chosen shall be compatible with the temperature rating of the cable and shall have no deleterious effect on any other comp. of cable)
		2. Type/ Grade	MA	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P/V	V	V	
1.6	PVC Compound (for sheath)	GENERAL :												
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	IS 5831	IS 5831	Test Cert.	✓	P/V	V	V	
		2. Elec. Properties	MA	Electrical Tests	-do-	-do-	-do-	-do-	-do-	✓	P/V	V	V	
		3. FRLS Properties (as applicable)	CR	Chemical/ Environ.	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P/V	V	V	
		SPECIFIC CHECKS :												
		a) Make	MA	Physical verification	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	V	
		b) Type/ Grade	MA	-do-	-do-	-do-	Approved	Approved	-do-	✓	P	V	V	

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Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal			

	MANUFACTURING QUALITY PLAN	SPEC No.: PE-TS-417-507 - E001 Rev 00	Date 06.12.2021
	CUSTOMER : TSGENCO	QP NO.: PE-V0-417-507-E912 Rev 02	
	PROJECT: 5X800 MW YADADRI TPS		SHEET 5 OF 12
	ITEM: HT XLPE CABLES		
	1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV	4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV	

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1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
							datasheet	datasheet						
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	✓	P	V	V	
1.7	Galvanised steel round wire/ formed wire strip/ Aluminium round wire for Armour (as applicable)	GENERAL :												
		1. Make	MA	Physical verification	Manufacturer std.	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Test Cert.	✓	P	V	V	
		2. Dimension	MA	Measurement	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P/V	V	V	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample *	Sample*	-do-	-do-	-do-	✓	P/V	V	V	*: SAMPLE FROM EACH ARMOUR SIZE/ BATCH /LOT
		4.Galvanization Quality	MA	Galv. Tests	-do-	-do-	IS 3975	IS 3975	-do-	✓	P/V	V	V	
1.8	Steel Drum	1. Phy. & Constructional checks	MA	Measurement	Mfr's Plant Std.	Mfr's Plant Std.	Approved drawing of steel drum	Approved drawing of steel drum	Inspection Report	✓	P	V	V	Rust preventive finish to be checked
		2. Surface finish	MA	Visual	-do-	-do-	-	Surface shall be smooth	-do-	✓	P	V	V	
		3. Dimension					Approved datasheet	Approved datasheet						

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Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal			

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	CUSTOMER : TSGENCO		
	PROJECT: 5X800 MW YADADRI TPS		SHEET 6 OF 12
	ITEM: HT XLPE CABLES 1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV 4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV		

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					6				*		**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
2.0 IN PROCESS														
2.1	**Wire Drawing**	1. Size	MA	Dimensional	Mfr's Std.	Mfr's Std.	Appd. Datasheet	Appd. Datasheet	Inspection Report	✓	P	V	V	
		2. Surface finish	MA	Visual	-do-	-do-	-	Surface shall be smooth	-do-	✓	P	V	V	
		3. % of Elongation	MA	Mechanical	-do-	-do-	IS 8130	IS 8130	-do-	✓	P	V	V	
2.2	**Stranding of wires**	1. No. of wires	MA	Counting	Mfr's Std.	Mfr's Std.	Appd. Datasheet	Appd. Datasheet	Inspection Report	✓	P	V	V	
		2. Resistance	CR	Electrical	-do-	-do-	-do-	-do-	-do-	✓	P	V	V	
		3. Sequence, lay length & Direction	MA	Visual, Meas.	One Sample of each size/ lot	-	Mfrs Std. / Appd. Datasheet	Mfrs Std. / Appd. Datasheet	-do-		P	V	V	
		4. Surface Finish	MA	Visual	100%	-	-	Surface shall be smooth	-do-		P	V	V	
		5. Dimension	MA	Measurement	One Sample of each size/ lot	-	Appd. Datasheet	Appd. Datasheet	-do-		P	V	V	
2.3	**Conductor Screening**	1. Surface Finish	MA	Visual	100%	-	-	Surface shall be smooth	Inpection Report		P	V	V	
		2. Radial Thickness	CR	Mechanical	One	-	IS 7098-II &	IS 7098-II &	-do-		P	V	V	

SUPPLIER			BHEL-PEM			FOR CUSTOMER REVIEW & APPROVAL		
QUALITY ASSURANCE			QUALITY					
	Sign & Date	Name		Sign & Date	Name		Sign & Date	Name
Prepared By:			Reviewed by:	kusum RITESH KUMAR JAISWAL	Kusum Gautam Ritesh Kumar Jaiswal	Approved by:		
Reviewed by:								

	MANUFACTURING QUALITY PLAN	SPEC No.: PE-TS-417-507 - E001 Rev 00	Date 06.12.2021
	CUSTOMER : TSGENCO	QP NO.: PE-V0-417-507-E912 Rev 02	
	PROJECT: 5X800 MW YADADRI TPS		SHEET 7 OF 12
	ITEM: HT XLPE CABLES		
	1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV	4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV	

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					6				*		**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
					Sample of each size/ lot		Appd. Datasheet	Appd. Datasheet						
2.4	Core Insulation (XLPE) (No repair permitted)	1. Surface finish	MA	Visual	100%	100%	-	Free from bulging, burnt particles, lumps, cuts & scratches	Inspection Report/ Test report	✓	P	V	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	V	# To be checked at starting & finished end of extruded length.
		3. Insulation Thickness	CR	Measurement	-do-	-	Appd. Datasheet	Appd. Datasheet	-do-		P	V	V	
		4. Dia over insulation	MA	Measurement	-do-	-	-do-	-do-	-do-		P	V	V	
		5. Tensile Strength & % Elongation	MA	Mechanical	100%	-	IS:7098-II	IS:7098-II	-do-		P	V	V	
2.5	Insulation Screening	NON METTALIC												
		1. Surface finish	MA	Visual	100%	100%	-	Surface shall be smooth	Inspection Report	✓	P	V	V	
		2. Thickness	CR	Measurement	One Sample of each	-do-	Appd. datasheet	Appd. Datasheet & IS 7098-II	-do-	✓	P	V	V	

SUPPLIER QUALITY ASSURANCE			BHEL-PEM QUALITY			FOR CUSTOMER REVIEW & APPROVAL		
	Sign & Date	Name		Sign & Date	Name		Sign & Date	Name
Prepared By:			Reviewed by:	kusum	Kusum Gautam	Approved by:		
Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal			

	MANUFACTURING QUALITY PLAN	SPEC No.: PE-TS-417-507 - E001 Rev 00	Date 06.12.2021
	CUSTOMER : TSGENCO	QP NO.: PE-V0-417-507-E912 Rev 02	
	PROJECT: 5X800 MW YADADRI TPS		SHEET 8 OF 12
	ITEM: HT XLPE CABLES		
	1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV	4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV	

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					6				*		**			
1	2	3	4	5	M	C/N	7	8	9	D	M	C	N	
					size/ lot									
		METALLIC												
		1. Dimension of tape	CR	Measurement	One Sample of each size/ lot	One Sample of each size/ lot	Appd. datasheet	Appd. datasheet	Inspection Report/ Test report	✓	P	V	V	
		2. Overlap of Tape Band	MA	-do-	-do-	-do-	Mfs Std.	Mfs Std.	-do-	✓	P	V	V	
		3. Tightness of Tape	MA	Visual	-do-	-do-	Mfs Std.	Mfs Std.	-do-	✓	P	V	V	
2.6	Core Laying	1. Dia over laid up core	MA	Measurement	One Sample of each size/ lot	One Sample of each size/ lot	Appd. Datasheet	Appd. Datasheet	Inspection Report	✓	P	V	V	
		2. Sequence of lay & direction	MA	Visual & Meas.	-do-	-do-	IS 7098-II & Mfr. Std.	IS 7098-II & Mfr. Std.	-do-	✓	P	V	V	
		3. Lay Length	MA	Measurement	-do-	-do-	-do-	-do-	-do-	✓	P	V	V	
2.7	InnerSheath Extrusion	1. Surface finish	MA	Visual	100%	-	-	Surface shall be smooth	Inspection Report		P	V	V	
		2. Thickness	CR	Measurement	One	-	Appd.	Appd. Datasheet	-do-		P	V	V	

SUPPLIER QUALITY ASSURANCE			BHEL-PEM QUALITY			FOR CUSTOMER REVIEW & APPROVAL		
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Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal			

	MANUFACTURING QUALITY PLAN	SPEC No.: PE-TS-417-507 - E001 Rev 00	Date 06.12.2021
	CUSTOMER : TSGENCO	QP NO.: PE-V0-417-507-E912 Rev 02	
	PROJECT: 5X800 MW YADADRI TPS		SHEET 9 OF 12
	ITEM: HT XLPE CABLES		
	1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV	4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV	

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 M	6 C/N	7	8	9	D	M	C	N	
					Sample of each size/ lot		Datasheet							
		3. Dia over inner sheath	MA	-do-	-do-	-	-do-	-do-	-do-		P	V	V	
2.8	Armour	1. No.of wires/Strips	MA	Counting	At the start of process	-	Mfr. Std.	Mfr. Std.	Inspection Report		P	V	V	
		2. Lay length & Direction	MA	Visual & Meas.	-do-	-	IS 7098-II	-do-	-do-		P	V	V	
		3. Dia over armouring	MA	Measurement	-do-	-	Appd. Datasheet	Appd. Datasheet	-do-		P	V	V	
		4. Coverage	MA	Measurement	-do-	-	-do-	-do-	-do-		P	V	V	
2.9	Outer Sheath Extrusion (No repair permitted)	1. Surface finish	MA	Visual	100%	-	-	Surface shall be smooth	Inspection Report/ Test report		P	V	V	Pimple, fish eye, porosity & burnt particles are not permitted
		2. Sheath Thickness	CR	Measurement	One Sample of each size/ lot	-	Appd. Datasheet	Appd. Datasheet & IS 7098-II	-do-		P	V	V	
		3. Dia over outer sheath	MA	-do-	-do-	-	-do-	-do-	-do-		P	V	V	
		4. Embossing/ Sequencial Marking	MA	Visual	100%	-	Approved data sheet	Approved data sheet	-do-		P	V	V	

SUPPLIER QUALITY ASSURANCE			BHEL-PEM QUALITY			FOR CUSTOMER REVIEW & APPROVAL		
	Sign & Date	Name		Sign & Date	Name		Sign & Date	Name
Prepared By:			Reviewed by:	kusum	Kusum Gautam	Approved by:		
Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal			

	MANUFACTURING QUALITY PLAN	SPEC No.: PE-TS-417-507 - E001 Rev 00	Date 06.12.2021
	CUSTOMER : TSGENCO	QP NO.: PE-V0-417-507-E912 Rev 02	
	PROJECT: 5X800 MW YADADRI TPS		SHEET 10 OF 12
	ITEM: HT XLPE CABLES 1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV 4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV		

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	
3.0	Finished Cable (INTERNAL)	1. Routine Test (Refer Note-H)	CR	Electrical Tests & Measurement	100%	100%	As per IS 7098-II	As per IS 7098-II	-do-	✓	P	V	V	#: Refer Annexure-A to QP
4.0	Final Inspection (EXTERNAL)	1. Finish & Length (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	✓	P	W	W	
		2. Dimension	MA	-do-	As per IS 7908-II	As per IS 7908-II	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	W	W	
		3. Armouring - Coverage No. of Wires/Strips	MA	Visual & Meas.	As per IS 7908-II	As per IS 7908-II	Appd. Datasheet	Appd. Datasheet	-do-	✓	P	W	W	
		4. Marking & Colour Coding	MA	Visual	As per IS 7098-II	As per IS	As per IS 7098-II	Approved Data Sheet	-do-	✓	P	W	W	
		5. Acceptance Tests (Refer Note-H)	CR	Phy, Elect. Tests & FRLS Tests	-do-	-do-	#	-do-	-do-	✓	P	W	W	#: Refer Annexure-A to QP.
		6. Type Tests (Refer Note-H)	CR	Physical & Electrical Tests	#	#	-do-	-do-	-do-	✓	P	W	W	#: Refer Annexure-A to QP.

SUPPLIER QUALITY ASSURANCE			BHEL-PEM QUALITY			FOR CUSTOMER REVIEW & APPROVAL		
	Sign & Date	Name		Sign & Date	Name		Sign & Date	Name
Prepared By:			Reviewed by:	kusum	Kusum Gautam	Approved by:		
Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal			

	MANUFACTURING QUALITY PLAN	SPEC No.: PE-TS-417-507 - E001 Rev 00	Date 06.12.2021
	CUSTOMER : TSGENCO	QP NO.: PE-V0-417-507-E912 Rev 02	
	PROJECT: 5X800 MW YADADRI TPS		SHEET 11 OF 12
	ITEM: HT XLPE CABLES		
	1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV	4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV	

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								
1	2	3	4	5			7	8	9	D	M	C	N	
5.0	Packing (Pre-dispatch checks)	1. Sealing Identification	MA	Visual	100%	100%	As per IS 7098-II	As per IS 7098-II	-	✓	P	W	V	
		2. Cable drums	MA	Visual	100%	100%	Appd. Datasheet	Appd. Datasheet	-	✓	P	W	V	

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). Packing shall be suitable for storage at site in tropical climate conditions.
N). Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.
O). In case of any discrepancy TSGENCO/BHEL's decision shall be final and testing shall be as per latest stnadards if not mentioned otherwise.

SUPPLIER QUALITY ASSURANCE			BHEL-PEM QUALITY			FOR CUSTOMER REVIEW & APPROVAL		
	Sign & Date	Name		Sign & Date	Name		Sign & Date	Name
Prepared By:			Reviewed by:	kusum	Kusum Gautam	Approved by:		
Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal			

	MANUFACTURING QUALITY PLAN		SPEC No.: PE-TS-417-507 - E001 Rev 00 QP NO.: PE-V0-417-507-E912 Rev 02	Date 06.12.2021
	CUSTOMER : TSGENCO			
	PROJECT: 5X800 MW YADADRI TPS			SHEET 12 OF 12
	ITEM: HT XLPE CABLES			
	1. 3CX240 Sq.mm 11/11kV 2. 1CX240 Sq.mm 11/11kV 3. 1CX630 Sq.mm 11/11kV	4. 3CX185 Sq.mm 3.3/3.3kV 5. 1CX240 Sq.mm 3.3/3.3kV		

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 M	6 C/N	7	8	9	D	M	C	N	

LEGENDS:

*Records, identified with "Tick"(√) shall be essentially included by supplier in QA documentation.

** **M**: Manufacturer/ Supplier / Sub-Supplier, **C**: BHEL/ Third Party Inspection Agency, **N**: TSGENCO/TPA

P: Perform, **W**: Witness, **V**: Verification, as appropriate

MA: Major, **MI**: Minor, **CR**: Critical, **D**: Documentation

SUPPLIER QUALITY ASSURANCE			BHEL-PEM QUALITY			FOR CUSTOMER REVIEW & APPROVAL		
	Sign & Date	Name		Sign & Date	Name		Sign & Date	Name
Prepared By:			Reviewed by:	kusum	Kusum Gautam	Approved by:		
Reviewed by:				RITESH KUMAR JAISWAL	Ritesh Kumar Jaiswal			

Annexure "A" to Quality Plan

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 1 drum for every 10 drums or less of each type and size of cable/ lot.
   b. Electrical tests to be conducted on one drum of every size & voltage grade of cables/LOT.
   c. FRLS test & Flammability Test to be conducted on every size & voltage grade of cables/LOT. Sampling quantity as per appendix –D of IS 7098-2, D2.2.

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 as per 1 drum for every 10 drums or less of each type and size of cable/ lot.
   b. FRLS test & Flammability Test to be conducted on every size & voltage grade of cables/LOT. Sampling quantity as per appendix –D of IS 7098-2, D2.2.

For both A & B sampling quantity as per appendix-D of IS 7098-2,D2.2

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. Sampling: Routine tests shall be conducted on 100% cable drums.

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	T, A	IS 10810 Pt 3	

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Annexure "A" to Quality Plan

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
		(Not applicable for compacted circular or shaped conductor)			
IV.	Resistance test	For Al/Cu	T, A, R	IS 10810 Pt 5	
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 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	**Physical Tests for XLPE Insulation & PVC sheath**				
I.	Test for thickness & Eccentricity	Applicable for XLPE insulation, HRPVC inner sheath & For HRPVC *inner/outer sheath* only	T, A	IS 10810 Pt 6	
II.	Tensile strength and elongation test at break	Applicable for XLPE insulation & For HRPVC *inner/outer sheath* only			
(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 & For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 10	
V.	Hot deformation test	For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 15	
VI.	Heat shock test	For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 14	
VII.	Shrinkage test	For XLPE insulation & For HRPVC *inner/outer sheath* only	T	IS 10810 Pt 12	

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Annexure "A" to Quality Plan

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
VIII.	Thermal stability test	For HRPVC *inner/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	
4.0	**Tests On Extruded Semi-conducting Screen**	**Not Applicable**			
I.	Volume Resistivity	Applicable for Semi-conducting bonded screen	T	IS 7098-II	
II.	Test for cross linking		A	IS 7098-II	
5.0	**Improved Fire performance (FR-LSH) Tests**				
I.	Oxygen index test	*For inner/outer sheath only*	T, A	IS 10810 Pt 58 / ASTMD 2863	*Sample shall be as per IS 7098,Part 2*
II.	Smoke density test	*For inner/outer sheath only*	T, A	ASTMD 2843	
III.	Acid gas generation test	*For inner/outer sheath only*	T, A	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	*For inner/outer sheath only*	T,A	IS 10810 Pt 64 / ASTMD 2863	
V.	Light Transmission test	*For inner/outer sheath only*	T, A	ASTMD 2843	**Min. 40%**
6.0	**Flammability Tests**				
I.	Flammability test for bunched cables	For complete cable	T,A	IEC-60332 (Part-3)	
II.	Flammability test for single cable	For complete cable	T,A	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	
7.0	**Electrical Tests**				
I.	High Voltage Test	For complete cable	T, A, R	IS 10810 Pt 45	

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Annexure "A" to Quality Plan

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
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 HRPVC sheathed cable*	*T*	*IS 10810 Pt 53*	
8.0	Anti-rodent and Termite Repulsion test	For HRPVC *outer sheath* only	A	Refer Note	
9.0	Anti-Fungal Test	For HRPVC outer sheath only		Self-certification by vendor for anti-fungal property.	

Note: A few chipping of the PVC compound is slowly ignited on a porcelain dish or cubicle in a muffle furnace at about 60 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.

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RITESH KUMAR JAISWAL

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	SPECIFICATION NO. PE-TS-417-507-E001
		VOLUME II
		SECTION I
		REVISION 00 / DATE: 27.04.2022
		SHEET - SHEET 1 of 4

DATASHEET A

1.0	Type of Cable	Flame Retardant-Low Smoke (FRLS)
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	11/11kV(UE) & 3.3/3.3kV(UE)
4.0	Number of cores, cross sectional area of conductors and quantities	3CX240 sq.mm(11/11kV, ARMOURED) 1CX630 sq.mm(11/11kV, ARMOURED) 1CX240 sq.mm(11/11kV, ARMOURED) 3CX185 sq.mm(3.3/3.3kV, ARMOURED) 1CX240 sq.mm(3.3/3.3kV, ARMOURED) As per BOQ cum price schedule (part of NIT)
5.0	**CONDUCTOR**	
(a)	Material	Aluminium
	Grade and Class	H2, Class 2
(b)	Standard Applicable	IS: 8130
(c)	Shape	Compacted Circular, Stranded
(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	Extruded (XLPE)
(b)	Standard Applicable	IS: 7098 (Part-2)
(c)	Continuous withstand temperature	90°C
(d)	Short-circuit withstand temperature	250°C
(e)	Nominal Thickness of Insulation	As per Table – 4 of IS 7098 Part-2
7.0	**INSULATION SCREEN**	**For both SINGLE CORE & MULTI CORE cables**
(a)	Non-metallic	
(i)	Material	Extruded semiconducting compound shall be bonded type. Semiconducting tape shall also be provided and it should be easily strippable.
(ii)	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	10%
(c)	Earth fault current withstand capacity	0.3kA, 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	Triple Extrusion Dry Cure (CCV) process using pressurized Nitrogen.
9.0	CORE IDENTIFICATION	By coloured strips applied on (For three core cables) cores.
10.0	INNER SHEATH	Applicable for all Cables
(a)	Material	Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831 for three and single core cables.
(b)	Standard Applicable	IS: 7098 (Part-2) & IS: 5831
(c)	Colour	Black
(d)	Whether FRLS	YES
(e)	Inner sheath applicable for single core cable	YES
(f)	Fillers	Acceptable
(g)	Material of fillers (if permitted)	Same as inner sheath (Material of filler to be compatible with that of inner sheath) (Fillers shall be solid & non hygroscopic)
(h)	Method of application	
(1)	Multi-core cables:	
(i)	With fillers	[√]Pressure extruded [√]Vacuum extruded
(ii)	Without fillers	Pressure extruded
(2)	Single Core Cable	[√]Pressure extruded [√]Vacuum extruded
(i)	Thickness of inner sheath	As per Table-5 of IS: 7098 (Part-2)
11.0	ARMOUR	
a)	Material	
(i)	Multicore cables	Galvanised single round steel wire armour for twin and multicore cables.
(ii)	Single core cables	Non-magnetic hard drawn aluminium single round wire conforming to H4 Grade of IS-8130 latest
b)	Minimum coverage	90%
c)	Gap between armour wires	Shall not exceed one armour wire space (No cross-over/over-riding)
d)	Breaking load of joint	95% of normal armour
12.0	OUTERSHEATH	
(a)	Material	Extruded FRLS HRPVC compound conforming to type ST2 of 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	Cable size (cross section area of conductor and no. of cores), voltage grade, Manufacturer's name and /or trade mark, year of manufacture, Type of insulation, Type of inner & outer sheath, "FRLS" word etc. Owner's identification mark i.e. "TSGENCO", "BHEL-PEM" and IS number @ 1m (by embossing). Progressive sequential marking @ 1m (by printing)

13.0	**FRLS CHARACTERISTICS**	
(a)	Oxygen index	Min 29 (As per ASTM-D 2863-77)
(b)	Temperature index	Min. 250°C at oxygen index 21% (As per NES-715)
(c)	Acid gas generation	Max. 20% (IEC-60754-1)
(d)	Smoke density rating	Max. 60% (As per ASTM D 2843-7)
(e)	Flame retardance properties	After the test, there should be no visible damages on the test specimen within 300mm from its upper end. After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 meter above the bottom edge of the burner, measured at the front and rear of the cable assembly.
(f)	Test for specific optical density of smoke	The cables shall meet the requirements of IS/IEC.
(g)	Rodent & Termite Test	The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound.
(h)	Flammability test	The test shall be carried on finished cables as per following Standards a) Swedish Chimney test – SS: 424-14-75 b) IEEE std.383 – 1974 latest c) IEC std. 332-1, 332-3
(i)	Light Transmission	40% Min (As per ASTM D-2843)
14.0	**TOLERANCE ON OUTER DIAMETER**	(±)2 mm. over the declared value
15.0	**CABLE DRUMS**	
(a)	Type of Drum	[√] Steel as per relevant IS
(b)	Standard drum length	As per BOQ cum Price Schedule
(c)	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.
(d)	Particular information on Drum	Owner's identification mark i.e. "TSGENCO" and "BHEL-PEM", Manufacturer's name and /or trade mark, Type of Cable & Voltage Grade, year of manufacture, Type of insulation, No. of core & Cable size, cable code, length of cable on drum, No. of length on drum (if more than one), direction of rotation(by arrow), approx. gross mass, IS/IEC number and ISI mark.

	DOCUMENT TITLE	SPECIFICATION NO. PE-TS-417-507-E001	
	TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	VOLUME II	
		SECTION I	
		REVISION 00	DATE: 27.01.2023
		SHEET 1 OF 5	

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	YES
2.2	IS: 8130 For conductor material	YES	YES
2.3	IS: 5831 For material of innersheath & outersheath	YES	YES
2.4	IS: 3975 / IS: 8130 For armour of 3 core/ single core cables	YES	YES
2.5	IS: 10810 For method of tests	YES	YES
2.6	ASTMD-2863 For oxygen index test	YES	YES
2.7	SS:424-14-75 & IEC-60332-3 & IEC-60332-1 & IEEE: 60383 For flammability test	YES	YES
2.8	IEC-60754-1 For acid gas generation test	YES	YES
2.9	ASTMD-2843 For smoke generation test	YES	YES
2.10	Current rating of cables conforms to	-	IS-3961(Pt 7):2017
2.11	Short circuit rating conforms to	-	IEC-60949
2.12	Formula for calculating short circuit current for different durations	-	KA/SQRT (t)
3.0	**INSTALLATION CONDITIONS AT SITE**		
3.1	Ambient air temperature	deg. C	50
3.2	Ground temperature	deg. C	30
3.3	Depth of laying of cables buried in ground	cm	90

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

3.4	Thermal resistivity of soil	deg. C cm/W	150
4.0	**INSTALLATION CONDITIONS FOR CURRENT RATING SPECIFIED AT CLAUSE 7.3**		
5.0	**CHARACTERISTICS OF FR-LSH SHEATH**		
5.1	Oxygen index	-	29% (Minimum) (as per ASTM D-2863)
5.2	Temperature index	-	250 DegC at oxygen index 21% (As per ASTM D-2863/NES-715)
5.3	Acid gas generation	-	20% Max. (As per IEC-754-1)
5.4	Smoke density rating	-	60% Max. (As per ASTM D-2843)
5.5	Light Transmission		40% Min. (As per ASTM D-2843)
5.6	Flammability Tests		
i)	Flammability test for single cable		Yes as per IEC-332 Part-1
ii)	Flammability test for bunched cable		Yes as per IEC-332 Part-3 (Cat-B)
iii)	Flammability test as per IEEE-60383		Yes
iv)	As per Swedish Chimney test SEN-SS-424-1475-F3		Yes (if applicable)
6.0	**CABLE DRUMS**		
6.1	Type & construction	-	Non-returnable steel drum
6.2	Standard drum length	-	
6.3	Tolerance on drum length	-	+/-5%
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	

	DOCUMENT TITLE	SPECIFICATION NO. PE-TS-417-507-E001	
	TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	VOLUME II	
		SECTION I	
		REVISION 00	DATE: 27.01.2023
		SHEET 3 OF 5	

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	-	H2 Grade Aluminum Conductor, Class-2
b)	No & dia of wires in each core before stranding	no x mm	
c)	Shape	-	Compacted circular conductor
7.7	CONDUCTOR SCREEN		
a)	Material	-	Extruded semi conducting compound
b)	Minimum thickness	mm	0.3
7.8	XLPE INSULATION		Extruded XLPE compound as per IS:7098 (Pt-II)/2011
a)	Nominal thickness of insulation	mm	
b)	Method of curing	-	
c)	Core Identification		
7.9	INSULATION SCREEN		
a)	Type of screen	-	Insulation screen shall consist of two parts 1. Non Metallic Part 2. Metallic Part
b)	Material and thickness (minimum and nominal)	mm	
i)	Metallic	-	Shall be copper & nonmagnetic tape
	No. of tapes and Minimum overlapping	-	One tape with nominal thickness of 0.1mm with tolerance (±) 10% & 10% Min overlap
ii)	Non-metallic	-	Extruded semiconducting compound shall be bonded type. Semiconducting tape shall also be provided and it should be easily strippable.

	DOCUMENT TITLE	SPECIFICATION NO. PE-TS-417-507-E001	
	TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	VOLUME II	
		SECTION I	
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iii)	Minimum Thickness		0.3 mm
iii)	Earth fault current withstand capacity (calculation to be furnished)	kA, sec.	0.3kA, 2 sec. (For multi-core cables, screen of each core shall be rated individually for the above value).
7.10	PVC ST2 INNERSHEATH		
a)	Material	-	Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831 for three and single core cables.
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)	-	Same as inner sheath (Material of filler to be compatible with that of inner sheath) (Fillers shall be solid & non hygroscopic)
e)	Colour	-	Black
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	-	
g)	Min. armour coverage		90%
7.12	PVC/POLYETHYLENE ST2 FR-LSH OUTERSHEATH		Extruded FRLS HRPVC compound conforming to type ST2 of IS: 5831
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	±2 mm
7.15	Minimum bending radius	x O.D.	
7.16	Safe pulling force	kg.	

	DOCUMENT TITLE	SPECIFICATION NO. PE-TS-417-507-E001	
	TECHNICAL SPECIFICATION FOR HT XLPE POWER CABLES	VOLUME II	
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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.

:

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 Standard Quality Plan 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. Bidders shall submit their list of proven sub-vendors for raw materials, which will be reviewed by BHEL/Customer.

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 The bidder shall furnish the reports of all the type tests listed in Annexure to QAP (enclosed with quality plan) carried out in within last five years of the date of bid opening. These reports should be for the tests conducted either in government approved third party laboratory or witnessed by client (such as major utilities/ industries) on identical/ similar cables to those ordered under this contract. (Refer Section-I, Cl. No. 3.1.1, S. No.1)

3.6 In case bidder is not able to submit report of type test(s) conducted in last five years, or in case type tests report(s) are not found to be meeting the specification/ relevant standard requirements, then all such tests shall be conducted under this contract by the bidder free of cost to BHEL, and reports shall be submitted for approval. No charges shall be paid for testing under such circumstances. (Refer Section-I, Cl. No. 3.1.1, S. No.1).

3.7 Irrespective of the bidder furnishing type test report as indicated above, BHEL may get type tests as indicated in Annexure to QAP (enclosed with quality plan) on the lots offered for inspection. Separate price shall be quoted for the conduction of type testing per lot, which shall be used for cost comparison. A maximum of three lots shall be considered for price comparison purposes on account of type testing. However, type-testing charges shall be paid as per type test conducted. (Refer Section-I, Cl. No. 3.1.1, S. No.1).

3.8 Minor changes in the final Type Test Procedures (which shall be to approval during contract stage) shall be without any commercial implication.

3.9 Cost of cables consumed for testing shall be to bidder's account.

3.10 Acceptance tests shall be conducted on every lot offered for inspection as per details indicated in Datasheet A & Quality Plan.

3.11 Routine testing shall be conducted in line with the applicable standards and as per the Manufacturing Quality Plan approved for the project for every lot offered for inspection.

3.12 Cost of conduction of routine and acceptance testing shall be deemed to have been included in the quoted supply prices.

4.0 Packing

4.1 Cables shall be supplied in non-returnable drums. Material of cable drums shall be as specified in Datasheet-A.

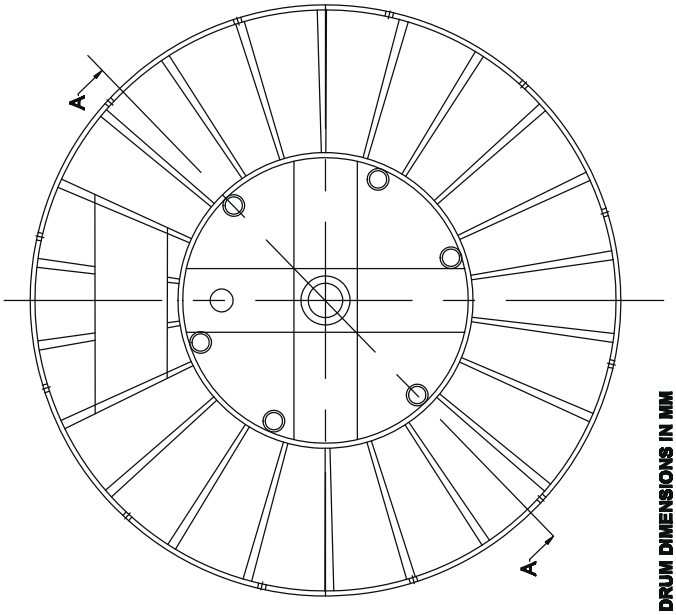
4.2 In case of wooden drums, all wooden parts shall be manufactured from seasoned wood treated with copper napthenates / zinc napthenates (refer IS: 401). Dimensions of wooden drums shall be as per IS 10418. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting 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.

STEEL DRUM DRAWING (TYPICAL)

ANNEXURE-C TO SECTION-II

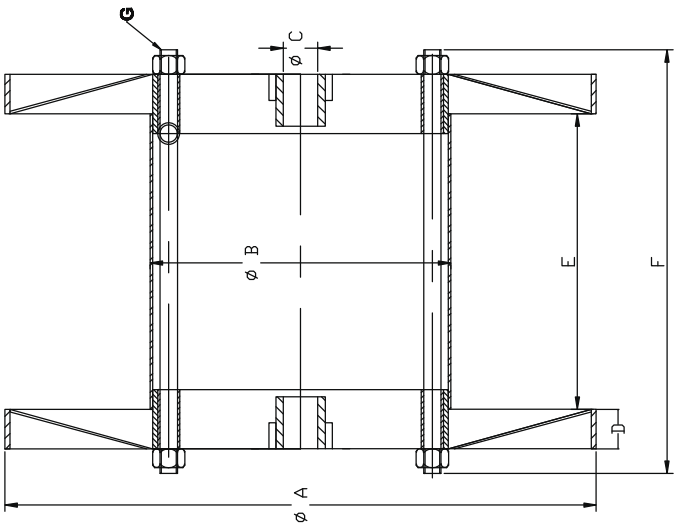
- Drg. not to scale.
- ALL DIMENSIONS ARE IN MM.



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.



1283959/2023/PS-PEM-EL

TECHNICAL PQR

भेल BHEL	YADADRI TPS (5X800 MW)	PE-PQ-417-507-E001
	PRE-QUALIFICATION REQUIREMENTS FOR HT XLPE POWER CABLES	REVISION NO. 00 DATE 27/06/2022
		Page 1 of 1

ITEMS: HT XLPE POWER CABLE SCOPE: Supply: YES; Erection & Commissioning: NO;	
1	Vendor should be a manufacturer of HT Cables
2	Availability of test reports on HT XLPE FRLS Power Cables to establish in-house capability to carry out all routine, type & acceptance tests as per relevant IS/International Standards (except UV Radiation & Hydrolytic Stability Test which can be conducted at Govt. lab/Govt. approved Independent lab).
3	Capacity of manufacturing 40km of HT XLPE Power Cables per month
4	Manufactured and supplied at least one (1) km of FRLS cables of any voltage level prior to 17.10.2017.
5	Manufactured & supplied HT XLPE Power Cable sizes of minimum 240sqmm for 3/3.5 core and minimum 630sqmm for single core cable
6a	Manufactured & supplied at least 50km of 6.35/11 KV or higher voltage grade XLPE insulated power cables in one or more orders prior to 17.10.2017.
6b	Manufactured & supplied at least 15km of 11kV/6.6kV/3.3kV XLPE insulated power cables in one single order.
7	Minimum two (2) nos. purchase orders for HT XLPE Power Cables shall be submitted which should not be more than five (5) years old from date of techno-commercial bid opening.

Notes (General points of PQR):

1. Consideration of offer shall be subject to customer's approval of bidder, if applicable.
2. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self-attested English translated document should also be submitted.
3. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities & capacity of the bidder to perform the contract, should the circumstance warrant such assessment in the overall interest of BHEL.
4. After satisfactory fulfilment of all the above criteria/requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.
5. Bidder to submit test reports as per PQR Clause No. 2 to establish vendor has in-house facility to conduct all tests including Impulse withstand test.
6. PQR 4 & 6a is in line with customer provenness criteria.

PREPARED BY	CHECKED BY	REVIEWED BY	APPROVED BY
P. Vinayaka 27/6/22	27.06.22	27/6/2022	29/6/22
PRATIK VINAYAKA, DY. MANAGER	N N JAJWARE, SR. MANAGER	PRAVEEN DUTTA, AGM	DEBASISA RATH, AGM (DH)

PVC Factors & Formulae

FOR PVC CLAUSE FOLLOWING ALSO TO BE NOTED:

- SMIFS/SMIF factor for 3.3KV Cable shall be as per formula given in IEEMA circular & SMIFS/SMIF factor for 11KV Cable shall be as per Table H3(a) & H3(b) of IEEMA circular attached with NIT. (All other factors shall be as per IEEMA circular attached with NIT).
- Factor of 3.3 KV (UE) Armoured (Screened cables) shall be as per factor of IEEMA Circular for 3.3kV (E) Unscreened Arm.

CIN No. U99999MH1970GAPO14629

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Ref. No. 91/DIV/CAB/05

9th October 2019

All Members of Cable Division & All SEBs, Utilities & Listed Purchasing organisations

Sub: i) Revision in Price Variation Formulae for Medium Voltage Power Cables
ii) New Price Variation Formula for 6 Quad Railway signalling Cables as per RDSO specs

IEEMA was working on inclusion of Metallic screen factors of copper tape applicable for the MV Power Cables and on specific request from Railways, IEEMA was also working on evolution of factors and formula for 6 Quad Railway Signalling Cables as per RDSO specifications.

IEEMA has been discussing internally on evolution of standards weight factors of metals and polymers applicable for EHV Cables for various standard rating and for specific short circuit test requirements.

After compilation of all inputs of factors from major manufacturers, the revised Price Variation Formulae for EHV Cables, MV Power Cables including metallic screen factor (Cu tape) have been prepared. Similarly a new PV formula for 6 Quad Railway signalling cables as per RDSO specification has also been prepared. The same in the draft form were circulated vide cir. No. 73/DIV/CAB/05 dated 23rd August 2019 for your reviews.

Since there are no adverse comments received; we are making these formulae operational from 1st September 2019. We request and recommend all the users & stakeholders including Utilities, PSUs etc. to incorporate these PV formulae in all the new tenders/contracts.

For pending contracts of EHV Cables and MV Power Cables, the date of delivery on or after 1st September 2019, to arrive at the final price variation, we recommend using the following two stage method, which is a standard institutionalized methodology adopted by IEEMA for change over in all IEEMA PV clauses.

1. Calculate price variation 'P' from applicable prices/indices from your base date / date of tendering up to September 2019 i.e. considering all prices/indices published in PV circular of September 2019 at numerator place; using IEEMA PV clause effective from 1st November 2017.

2. Treat the above calculated 'P' as 'P_0' and calculate final price variation considering all prices / indices published in September 2019 as base prices/indices (at the denominator place) up to the applicable prices/indices as per your date of delivery; using revised PV clause of MV Power Cable effective from 1st September 2019.

Director

Encl: Revised PV Formulae for EHV Cables, Medium Voltage Power Cables
New PV Formula for 6 Quad Railway signaling Cables as per RDSO specs

CIN No. U99999MH1970GAPO14629

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IEEMA (PVC)/MV SCREEN CABLE/2019 **Effective from: 1st September 2019**

Price Variation Clause for 3.3-33 KV XLPE Insulated Armoured Single & Three core Screen Cables

The Price quoted/confirmed is based on the input cost of raw materials/components as on the date of quotation, and the same is deemed to be related to the prices of raw materials as specified in the price variation clause given below. In case of any variation in these prices, the price payable shall be subject to adjustment up or down in accordance with the formulae provided in this document.

Terms used in price variation formulae:

P Price payable as adjusted in accordance with above appropriate formula **(in Rs/Km)**
Po Ex-Works Price quoted/confirmed **(in Rs/Km)**

ALUMINIUM

AlF Variation factor for Aluminium

Al Price of Aluminium. This price is as applicable one month prior to the date of delivery.
Alo Price of Aluminium. This price is as applicable one month prior to the date of tendering.

COPPER

CuF Variation factor for copper

Cu Price of CC copper rods. This price is as applicable one month prior to the date of delivery.
Cuo Price of CC copper rods. This price is as applicable one month prior to the date of tendering.

PVC COMPOUND

PVCc price of PVC compound. This price is as applicable on first working day of the month, one month prior to the date of delivery.
PVCco Price of PVC compound. This price is as applicable on first working day of the month, one month prior to the date of tendering.

CCFAl Variation factor for PVC compound/Polymer for aluminum conductor cable.
CCFCu Variation factor for PVC compound/Polymer for copper conductor cable.

XLPE COMPOUND

Cc price of XLPE compound. This price is as applicable on first working day of the month, one month prior to the date of delivery.
Cco Price of XLPE compound. This price is as applicable on first working day of the month, one month prior to the date of tendering.

XLFAL Variation factor for XLPE compound for aluminum conductor cable.
XLFCU Variation factor for XLPE compound for Copper conductor cable.

IEEMA (PVC)/MV SCREEN CABLE/2019 **Effective from: 1st September 2019**

STEEL

FeF	Variation factor for steel
FeW	Variation factor for round wire steel armouring
Fe	Price of Steel Strips/steel wire. This price is as applicable on the first working day of the month, one month prior to the date of delivery.
Feo	Price of steel strips/steel wire. This price is as applicable on first working day of the month, one month prior to the date of tendering.

COPPER TAPE

SMIFS	Variation Factor for Copper Tape
SMIF1	Price of CC copper rods. This price is as applicable one month prior to the date of delivery.
SMIF0	Price of CC copper rods. This price is as applicable one month prior to the date of tendering.

The above prices and indices are as published by IEEMA vide Circular reference IEEMA (PVC)/CABLE(R-1)/--/-- prevailing as on 1st working day of the month i.e. one month prior to the date of tendering.

The date of delivery is the date on which the cable is notified as being ready for inspection/dispatch (in the absence of such notification, date of manufacturer's dispatch note is to be considered as the date of delivery) or contracted delivery date (including any agreed extension thereto) whichever is earlier.

Notes: All prices of raw materials are exclusive of GST amount. The details of prices are as under:

1. Price of Aluminium is LME average Cash SELLER Settlement price of Primary Aluminium in US$ per MT as published by London Metal Bulletin (LME) including Premium for Aluminium Ingot in US$ per MT is converted in Indian Rs./MT.
2. Price of PVC Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer.
3. Price of XLPE Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer
4. Price of CC copper rods (in Rs/MT) is ex-works price as quoted by the primary producer.
5. Price of galvanized steel strip / steel wire (in Rs/MT) is ex-works price as quoted by the manufacturer for Round steel Wire and Flat steel strip (the relevant price of steel strip or steel wire is to be selected depending upon the type of armouring of the cable).

Price variation formulae

G. For Aluminium conductor XLPE insulated 3.3 to 33 kV Single Core Armoured power cables

$$P = Po + AlF\ (Al - Alo) + XLFAL(CC-Cco) + SMIFS\ (SMIF1-SMIF0) + CCFAl\ (PVCc - PVCco)$$

For Single Core unarmoured cables Aluminium factor (AlF) shall be referred from Table ALP

Table References:

ALP	Aluminium conductor Factor in single core (for unarmoured cable) ; AlF
H1	Aluminium Armour Factor for Armour with Al Cond.
H2(a)	XLPE Compound Factor ; XLFAl
H3(a)	Copper Tape Factor ; SMIFS
H5(a)	Polymer factor for Single core cable ; CCFAl

IEEMA (PVC)/MV SCREEN CABLE/2019 **Effective from: 1st September 2019**

Note: For cases where specific Earth Fault Current through Screen is required, Screen area as approved by the customer in Datasheet/Earth Fault Current calculation of Screen shall be used to derive SMIF as below
If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet
D= Density= 8.89 for Cu. & 2.703 for Al **SMIFS=(A*D)/1000**

H. For Copper conductor XLPE insulated 3.3 to 33 kV Single Core Armoured power cables

P = Po + CuF (Cu – Cu0) + XLFCu(CC-Cco)+ SMIFS (SMIF1-SMIF0) + AlF(Al-Alo) + CCFAl (PVCc – PVCco)

For Single Core unarmoured cables Aluminium factor (AlF) shall be 0

Table References:

CuP	Copper conductor Factor in single core ; CuF
H2(a)	XLPE Compound Factor ; XLFCu
H3(a)	Copper Tape Factor ; SMIFS
H4(a)	Aluminium Armour factor ; AlF
H5(a)	Polymer factor for Single core cable ; CCFCu

Note: For cases where specific Earth Fault Current through Screen is required, Screen area as approved by the customer in Datasheet/Earth Fault Current calculation of Screen shall be used to derive SMIF as below

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet
D= Density= 8.89 for Cu. & 2.703 for Al
SMIFS=(A*D)/1000

I. For Aluminium conductor XLPE insulated 3.3 to 33 kV Three Core Armoured power cables

P = Po + AlF (Al – Alo) + XLFAL(CC-Cco)+ SMIF (SMIF1-SMIF0) + FeF(FeF1-FeF0) + CCFAl (PVCc – PVCco)

For unarmoured Three Core cables , Steel Armour factor (FeF for Strip & FeW for Wire) shall be 0

Table References:

ALP	Aluminium conductor Factor in three core ; AlF
H2(b)	XLPE Compound Factor ; XLFAl
H3(b)	Copper Tape Factor ; SMIF
H4(b)	Steel Strip Armour Factor ; FeF. For Steel Wire Armour Refer Table H4(c); FeW
H5(b)	Polymer factor for Three Core cable ; CCFAl

Note: For cases where specific Earth Fault Current through Screen is required, Screen area as approved by the customer in Datasheet/Earth Fault Current calculation of Screen shall be used to derive SMIF as below

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet
D= Density= 8.89 for Cu. & 2.703 for Al
SMIF=(A*D)/1000

J. For Copper conductor XLPE insulated 3.3 to 33 kV Three Core Armoured power cables

P = Po + CuF (Cu – Cuo) + XLFCu(CC-Cco)+ SMIF(SMIF1-SMIF0) + FeF(FeF1-FeF0) + CCFCu (PVCc - PVCco)

For Three Core unarmoured cables , Steel Armour factor (FeF for Strip & FeW for Wire) shall be 0

Table References:

CuP	Copper conductor Factor in three core ; CuF
H2(b)	XLPE Compound Factor ; XLFCu
H3(b)	Copper Tape Factor ; SMIF
H4(b)	Steel Strip Armour Factor ; FeF. For Steel Wire Armour Refer Table H4(c); FeW
H5(b)	Polymer factor for Three Core cable ; CCFCu

Note: For cases where specific Earth Fault Current through Screen is required, Screen area as approved by the customer in Datasheet/Earth Fault Current calculation of Screen shall be used to derive SMIF as below

If A= Area of Metallic Screen in Approved Datasheet / Calculation Sheet
D= Density= 8.89 for Cu. & 2.703 for Al
SMIF=(A*D)/1000

The PV factor for metallic screen will be computed based on approved screen area in case of cables having a specific short circuit capacity

Authorized Signatory

TABLE ALP

VARIATION FACTOR FOR ALUMINIUM (AIF)
POWER CABLES WITH ALUMINIUM CONDUCTOR
(EXCLUDING SINGLE CORE ARMOURED CABLES)

Nominal Cross Sectional Area (in Sq. mm.)	1 core	2 core	3 core	3.5 core	4 core
2.5	0.007	0.014	0.021	-	0.028
4	0.011	0.023	0.034	-	0.046
6	0.017	0.034	0.052	-	0.069
10	0.029	0.053	0.087	-	0.116
16	0.046	0.091	0.137	-	0.183
25/16	0.073	0.146	0.219	0.262	0.292
35/16	0.101	0.202	0.302	0.345	0.404
50/25	0.137	0.273	0.410	0.478	0.547
70/35	0.197	0.395	0.593	0.687	0.791
95/50	0.274	0.548	0.821	0.949	1.095
120/70	0.346	0.691	1.036	1.221	1.382
150/70	0.425	0.853	1.279	1.464	1.706
185/95	0.533	1.070	1.605	1.861	2.140
225/120	0.655	1.310	1.965	2.287	2.620
240/120	0.703	1.400	2.099	2.421	2.799
300/150	0.879	1.757	2.635	3.033	3.514
400/185	1.126	2.249	3.374	3.873	4.498
500	1.418	2.838	4.256	-	5.675
630	1.828	3.663	5.494	-	7.326
800	2.340	4.679	7.018	-	9.357
1000	2.951	5.890	8.834	-	11.779

TABLE CUP

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)
POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	1 core	2 core	3 core	3.5 core	4 core
2.5	0.023	0.046	0.069	-	0.092
4	0.036	0.076	0.112	-	0.151
6	0.056	0.112	0.171	-	0.227
10	0.095	0.174	0.286	-	0.382
16	0.151	0.299	0.451	-	0.602
25/16	0.240	0.480	0.720	0.862	0.960
35/16	0.332	0.664	0.993	1.135	1.329
50/25	0.451	0.898	1.348	1.572	1.799
70/35	0.648	1.299	1.950	2.260	2.602
95/50	0.901	1.802	2.700	3.121	3.601
120/70	1.138	2.273	3.407	4.016	4.545
150/70	1.398	2.806	4.207	4.815	5.611
185/95	1.753	3.519	5.279	6.121	7.038
225/120	2.154	4.309	6.463	7.522	8.617
240/120	2.312	4.605	6.904	7.963	9.206
300/150	2.891	5.779	8.667	9.976	11.558
400/185	3.703	7.397	11.097	12.738	14.794
500	4.664	9.334	13.998	-	18.665
630	6.012	12.048	18.070	-	24.095
800	7.696	15.389	23.082	-	30.775
1000	9.706	19.372	29.055	-	38.741

Table : H1

VARIATION FACTOR FOR ALUMINIUM (AIF)

ALUMINIUM ARMOURED SINGLE CORE XLPE INSULATED 3.3 TO 33 KV CABLES

Nominal Cross Sectional Area (in Sq. mm.)	Aluminium Factor for Aluminium Armoured Cable with Aluminium Conductor					
	3.3 KV(E) unscreened Arm	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
35	0.251	0.284	0.301	0.344	0.358	0.473
50	0.312	0.336	0.352	0.397	0.408	0.672
70	0.385	0.409	0.423	0.469	0.501	0.723
95	0.476	0.500	0.518	0.637	0.656	0.856
120	0.561	0.586	0.601	0.726	0.744	0.949
150	0.653	0.678	0.696	0.823	0.842	1.050
185	0.773	0.797	0.893	0.949	0.965	1.183
240	0.997	1.063	1.083	1.139	1.154	1.387
300	1.209	1.271	1.283	1.333	1.307	1.753
400	1.438	1.556	1.565	1.620	1.636	2.046
500	1.873	1.901	1.910	2.110	2.128	2.484
630	2.337	2.361	2.369	2.580	2.595	2.978
800	3.007	3.071	3.080	3.145	3.163	3.588
1000	3.737	3.741	3.749	3.804	3.822	4.565

TABLE : H2 (a)
VARIATION FACTOR FOR XLPE(XLFAl/XLFCu)
SINGLE CORE ARMOURED /UNARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross-Sectional Area (in Sq. mm.)	XLPE Factor for Armoured/ Unarmoured Cable with AL /CU Conductor					
	3.3 KV(E) unscreened Arm	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	0.110	0.131	0.170	0.279		
35	0.122	0.137	0.175	0.284	0.317	0.522
50	0.135	0.151	0.191	0.307	0.341	0.563
70	0.155	0.172	0.215	0.342	0.379	0.615
95	0.174	0.193	0.241	0.377	0.417	0.670
120	0.192	0.212	0.262	0.407	0.449	0.713
150	0.209	0.229	0.283	0.437	0.481	0.757
185	0.228	0.250	0.308	0.471	0.518	0.809
240	0.255	0.279	0.343	0.519	0.569	0.883
300	0.280	0.322	0.372	0.560	0.613	0.943
400	0.326	0.392	0.420	0.625	0.683	1.041
500	0.388	0.461	0.469	0.694	0.757	1.142
630	0.467	0.520	0.529	0.777	0.845	1.265
800	0.567	0.593	0.602	0.874	0.949	1.407
1000	0.656	0.665	0.660	0.955	1.036	1.525

Note : XLPE factors include Semicons for Conductor & Insulation screen

TABLE – H2 (b)
VARIATION FACTOR FOR XLPE (XLFAl/XLFCu)
THREE CORE ARMOURED /UNARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross-Sectional Area (in Sq. mm)	3.3 KV unscreened Arm	6.6 KV (E) ARM	6.6 KV (UE)/ 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM
25	0.315	0.394	0.511	0.838		
35	0.339	0.427	0.545	0.880	0.982	1.638
50	0.378	0.474	0.600	0.957	1.065	1.751
70	0.435	0.541	0.679	1.067	1.183	1.916
95	0.489	0.604	0.755	1.171	1.295	2.071
120	0.537	0.661	0.822	1.265	1.396	2.210
150	0.585	0.719	0.890	1.359	1.497	2.350
185	0.642	0.784	0.968	1.468	1.614	2.513
240	0.717	0.873	1.074	1.615	1.773	2.732
300	0.781	1.006	1.167	1.744	1.928	2.919
400	0.886	1.227	1.314	1.948	2.130	3.229
500	0.956	1.421	1.446	2.148	2.381	3.588
630	1.129	1.582	1.609	2.382	2.630	3.940

Note : XLPE factors include Semicons for Conductor & Insulation screen

TABLE – H3 (a)

VARIATION FACTOR FOR COPPER TAPE (SMIFS)

SINGLE CORE ARMOURED /UNARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross-Sectional Area in sq.mm.	6.6 KV (E)	6.6 KV (UE) / 11 KV (E)	11 KV (UE)	22 KV (E)	33 KV (E)
	ARM	ARM	ARM	ARM	ARM
35	0.0181	0.0201	0.0249	0.0263	0.0163
50	0.0194	0.0215	0.0263	0.0277	0.0348
70	0.0217	0.0237	0.0285	0.0299	0.0370
95	0.0237	0.0257	0.0305	0.0319	0.0387
120	0.0254	0.0275	0.0323	0.0337	0.0408
150	0.0273	0.0291	0.0339	0.0353	0.0424
185	0.0292	0.0313	0.0361	0.0375	0.0446
240	0.0322	0.0340	0.0388	0.0401	0.0472
300	0.0351	0.0364	0.0426	0.0426	0.0497
400	0.0403	0.0411	0.0457	0.0471	0.0543
500	0.0446	0.0450	0.0499	0.0513	0.0582
630	0.0494	0.0496	0.0544	0.0558	0.0630
800	0.0545	0.0547	0.0595	0.0609	0.0681
1000	0.0598	0.0584	0.0645	0.0659	0.0731

TABLE – H3 (b)

VARIATION FACTOR FOR COPPER TAPE (SMIF)

THREE CORE ARMOURED /UNARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross-Sectional Area in sq.mm.	6.6 KV (E)	6.6 KV (UE) / 11 KV (E)	11 KV (UE)	22 KV (E)	33 KV (E)
	ARM	ARM	ARM	ARM	ARM
35	0.0549	0.0607	0.0717	0.0790	0.0000
50	0.0590	0.0649	0.0755	0.0831	0.1044
70	0.0654	0.0712	0.0822	0.0895	0.1110
95	0.0714	0.0773	0.0882	0.0955	0.1171
120	0.0771	0.0829	0.0939	0.1012	0.1225
150	0.0818	0.0878	0.0989	0.1062	0.1278
185	0.0884	0.0943	0.1052	0.1125	0.1341
240	0.0968	0.1026	0.1136	0.1209	0.1425
300	0.1062	0.1102	0.1216	0.1289	0.1497
400	0.1216	0.1238	0.1348	0.1422	0.1638
500	0.1353	0.1356	0.1467	0.1545	0.1762
630	0.1485	0.1491	0.1602	0.1680	0.1897

TABLE : H4 (a)
VARIATION FACTOR FOR ALUMINIUM (AIF)
SINGLE CORE ARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Cu CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	Aluminium Factor for Aluminium Armoured Cable with Copper Conductor					
	3.3 KV(E) unscreened Arm	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
35	0.153	0.187	0.204	0.247	0.258	0.372
50	0.179	0.203	0.220	0.262	0.275	0.425
70	0.196	0.219	0.233	0.278	0.311	0.444
95	0.213	0.237	0.254	0.373	0.392	0.470
120	0.228	0.253	0.268	0.393	0.410	0.488
150	0.243	0.269	0.287	0.414	0.432	0.504
185	0.261	0.285	0.381	0.437	0.455	0.526
240	0.324	0.389	0.410	0.465	0.480	0.556
300	0.365	0.428	0.440	0.490	0.510	0.737
400	0.432	0.471	0.480	0.536	0.552	0.783
500	0.489	0.517	0.526	0.726	0.744	0.844
630	0.544	0.568	0.572	0.787	0.801	0.902
800	0.706	0.787	0.797	0.862	0.880	0.982
1000	0.824	0.865	0.867	0.923	0.940	1.324

TABLE : H4 (b)
VARIATION FACTOR FOR STEEL STRIP ARMOUR (FeF)
THREE CORE ARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross Sectional Area Sq. mm.	3.3 KV (E) unscreened arm	6.6 KV (E)	11 KV (E) / 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	0.551	0.604	0.656	0.814		
35	0.645	0.645	0.731	0.879	0.937	-
50	0.675	0.703	0.761	0.937	0.966	1.181
70	0.761	0.761	0.849	0.996	1.055	1.289
95	0.820	0.849	0.907	1.083	1.113	1.348
120	0.879	0.907	0.966	1.142	1.172	1.406
150	0.966	0.966	1.055	1.201	1.259	1.494
185	1.025	1.055	1.113	1.259	1.318	1.553
240	1.142	1.142	1.231	1.377	1.406	1.641
300	1.231	1.259	1.318	1.465	1.524	1.758
400	1.348	1.406	1.435	1.582	1.641	1.876

TABLE : H4 (c)
VARIATION FACTOR FOR STEEL WIRE ARMOUR (FeW)
THREE CORE ARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross Sectional Area in Sq. mm	3.3 KV (E) Unscreened arm	6.6 KV (E)	11 KV (E) / 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	1.258	1.457	1.612	2.509	1.503	--
35	1.361	1.569	1.853	2.644	2.797	2.517
50	1.682	1.687	2.321	2.800	2.921	4.569
70	2.033	1.979	2.503	3.219	3.347	4.809
95	2.202	2.507	2.718	4.019	4.200	5.437
120	2.371	2.675	2.882	4.241	4.416	6.713
150	2.870	2.847	3.265	4.447	4.621	6.976
185	3.121	3.309	4.148	4.726	5.289	7.356
240	3.758	4.227	4.442	5.442	6.651	7.718
300	4.099	5.024	5.182	6.894	7.084	8.187
400	5.750	6.572	6.658	7.433	7.657	8.760
500	6.716	6.777	6.861	7.588	7.797	8.830
630	7.492	7.465	7.477	8.209	8.386	9.413

TABLE : H5 (a)
VARIATION FACTOR FOR Polymer (CCFAL/CCFCu)
SINGLE CORE ARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	3.3 KV(E) Unscreened ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM
35	0.123	0.259	0.278	0.330	0.376	0.468
50	0.152	0.272	0.294	0.379	0.394	0.483
70	0.170	0.295	0.317	0.404	0.419	0.508
95	0.184	0.317	0.338	0.435	0.449	0.554
120	0.197	0.337	0.392	0.457	0.472	0.576
150	0.194	0.389	0.413	0.477	0.492	0.597
185	0.224	0.414	0.445	0.502	0.539	0.674
240	0.276	0.456	0.479	0.558	0.573	0.711
300	0.294	0.489	0.506	0.587	0.602	0.811
400	0.333	0.569	0.578	0.687	0.703	0.866
500	0.367	0.675	0.679	0.809	0.826	1.056
630	0.438	0.735	0.739	0.873	0.928	1.168
800	0.529	0.863	0.866	1.027	1.05	1.189
1000	0.648	1.031	1.035	1.138	1.158	1.402

TABLE : H5 (b)
VARIATION FACTOR FOR POLYMER (CCFAI / CCFCu)
THREE CORE ARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH Al / Cu CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm	3.3 KV ARM Unscreen ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM
35	0.374	0.990	1.142	1.604	1.782	-
50	0.445	1.119	1.260	1.834	2.046	2.864
70	0.547	1.290	1.396	2.011	2.284	3.219
95	0.594	1.440	1.647	2.269	2.428	3.367
120	0.732	1.692	1.877	2.498	2.715	3.646
150	0.812	1.906	2.061	2.767	2.931	3.927
185	0.960	2.086	2.406	3.028	3.180	4.166
240	1.130	2.484	2.744	3.398	3.580	4.589
300	1.219	2.912	3.161	3.840	4.016	5.029
400	1.313	3.530	3.664	4.353	4.666	5.736
500	1.652	3.925	3.971	4.621	4.878	5.913
630	1.949	4.487	4.982	5.225	5.477	6.696

Fillers added in PVC consumption

Annexure-B

5X800 MW YADADRI TPS

BOQ-CUM-PRICE SCHEDULE FOR HT XLPE POWER CABLES (MAIN SUPPLY)

Sr. No.	Item code	Item description	Unit	Total Quantity (metres)	Drum Length (Meters)	UNIT EX-WORKS PRICE (DULY PACKED) (INR)	TOTAL EX-WORKS PRICE(DULY PACKED) (INR)	FREIGHT CHARGES WITHOUT GST @....% OF TOTAL EX WORKS (INR)	TOTAL PRICES (Total Ex works + Freight(as applicable)) (INR)	APPLICABLE GST @....% On(TOTAL EX WORKS + FREIGHT) (INR)	TOTAL PRICE F.O.R SITE PRICE (INR
1.0		**11/11 KV AL. CONDUCTOR/ XLPE INSULATED/ARMOURED/ UNEARTHED GRADE POWER CABLE**									
1.1	507-27151-A	3C-240	MTR	22,000	500						
1.2	507-27009-A	1C-240	MTR	3,000	1,000						
1.3	507-27025-A	1C-630	MTR	58,000	1,000						
2.0		**3.3/3.3 KV AL. CONDUCTOR/ XLPE INSULATED/ARMOURED/ UNEARTHED GRADE POWER CABLE.**									
2.1	507-27150-A	3C-185	MTR	3,000	750						
2.2	507-27053-A	1C-240	MTR	12,500	500						
NOTES:			TOTAL								

1.Total Quantity indicated above shall be known as Order Quantities. The total quantity variation shall be as per NIT.

2. Order Quantity indicated above shall be cleared for manufacturing along with PO. However, manufacturing of the cables shall be taken up by the successful bidder only after approval of technical and quality documentation. Subsequent lots if any, shall be cleared for manufacturing based on progress of engineering and site requirements.

3. Standard drum length shall be as per BOQ cum price schedule against each size of cable. Tolerance on individual drum length shall be ±5%. For each individual cable size, one short length of not less than 200m may be accepted only in the final drum length to complete the supply. The overall tolerance limits stipulated above shall continue to apply (in case short lengths are accepted).

4. Overall tolerance on total dispatched quantity of each size shall be (-) 2% and (+) 0% except where the total ordered quantity is one single drum length, in which case it shall be -5% to 0%. Cables consumed for testing and inspection shall be to bidder’s account.

5. In case of the quantities cleared by BHEL for manufacturing are manufactured and offered for inspection by successful bidder in more than one batch, BHEL reserves the right to witness type testing on all batches without any price implications.

6. Bidder shall indicate unit price of cables inclusive of type test charges, No separate charges shall be payable for type tests.

7. Unit Price for Mandatory Spares shall be same as that of Main supply items

5X800 MW YADADRI TPS

BOQ-CUM-PRICE SCHEDULE FOR HT XLPE POWER CABLES (MANDATORY SPARES)

Sr. No.	Item code	Item description	Unit	Total Quantity (metres)	Drum Length (Meters)	UNIT EX-WORKS PRICE (DULY PACKED) (INR)	TOTAL EX-WORKS PRICE(DULY PACKED) (INR)	FREIGHT CHARGES WITHOUT GST @....% OF TOTAL EX WORKS (INR)	TOTAL PRICES (Total Ex works + Freight(as applicable)) (INR)	APPLICABLE GST @….% On(TOTAL EX WORKS + FREIGHT) (INR)	TOTAL PRICE F.O.R SITE PRICE (INR
1.0		**11/11 KV AL. CONDUCTOR/ XLPE INSULATED/ ARMOURED/ UNEARTHED GRADE POWER CABLE**									
1.1	507-27151-A	3C-240	MTR	1,000	500						
1.2	507-27009-A	1C-240	MTR	1,000	500						
1.3	507-27025-A	1C-630	MTR	1,000	500						
TOTAL											

FINANCIAL PQR

PRE - QUALIFYING REQUIREMENTS

ENQUIRY NO:	
PROJECT:	5X800 MW YADADRI TPS
PACKAGE:	HT XLPE Cables

CRITERIA FOR EVALUATION - FINANCIAL :

	Amount (in Rs.)
Average annual financial turnover during the last Three Financial Years should not be less than RUPEES NINE CRORE(S) THREE LAKH(S) THIRTY SIX THOUSAND(S) ONLY	Rs.9,03,36,000/-

Notes:-

a) The bidder has to submit financial accounts (audited, if applicable comprising of Audit report, Balance Sheet, Profit & Loss A/c Statement and Notes/Schedules pertaining to Turnover/Sales/Revenue), for last three years (or from the date of incorporation, whichever is less) as on tender due date to review the above criteria. In case the incorporation of vendor is less than 3 years, average annual financial turnover shall be calculated based on available information as below:-

i) If the accounts are available for <= 1 Financial Year, the Average Annual Turnover shall be calculated based on available information divided by 1 (One).

ii) If the accounts are available for >1 but < = 2 Financial Years, the Average Annual Turnover shall be calculated based on available information divided by 2 (Two).

iii) If the accounts are available for >2 but <= 3 Financial Years, the Average Annual Turnover shall be calculated based on available information divided by 3 (Three).

b) Foreign bidder is to submit a latest report from reputed third party business rating agency like Dun & Bradstreet, Credit reform etc. in addition to the documents mentioned at point (a) above for review of above criteria.

c) Other Income shall not be considered for arriving at Annual Turnover/Sales.For evaluation purpose,turnover figure excluding taxes shall be considered.

d) For evaluation of foreign bidder, exchange rate (TT selling rate of SBI) as on scheduled date of tender opening (Part-I bid in case of two part bid) shall be considered.