1 x 660 MW BHUSAWAL TPS, UNIT-6

MAHARASHTRA STATE POWER GENERATION CORPORATION LIMITED

TECHNICAL SPECIFICATION FOR LT CONTROL CABLES

VOLUME-II

SPECIFICATION NO: PE-TS-415-507-E004

REVISION: 00

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

534383/2021/PS-PEM-EL

	TECHNICAL SPECIFICATION FOR LT CONTROL CABLES	SPECIFICATION NO. PE-TS-415-507-E004	
		VOLUME II	
		SECTION	
		REVISION 0	DATE:14.10.2021
		SHEET 1 OF 1	

CONTENTS

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

	TECHNICAL SPECIFICATION FOR LT CONTROL CABLES	SPECIFICATION NO. PE-TS- 415-507-E004
		VOLUME II
		SECTION I
	BHUSAWAL TPS (1 X 660MW)	REVISION – 00 / DATE: 14.10.2021
		SHEET -

COMPLIANCE CERTIFICATE

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

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'

3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in Annexure-A [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

	TECHNICAL SPECIFICATION FOR LT CONTROL CABLES BHUSAWAL TPS (1 X 660MW)	SPECIFICATION NO. PE-TS-415-507-E004	
		VOLUME II	
		SECTION I	
		REVISION - 00	DATE: 14.10.2021
		SHEET 1 of 2	

1.0 SCOPE OF ENQUIRY

1.1 This specification covers the Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of LT CONTROL CABLES conforming to the Specification.

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

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

1.4 The stipulations of Section-I, followed by those of Data Sheet-A shall prevail in case of any conflict between the stipulations of Section-I, Data Sheet - A & Section-II.

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

2.0 BILL OF QUANTITIES:

2.1 Quantity requirements shall be as per Annexure for Bill of Quantities (BOQ) enclosed as part of NIT.

3.0 SPECIFIC TECHNICAL REQUIREMENTS

Sl. No	Reference Clause No. of Section-II/ Quality Plan	Specific Requirement/ Change
1.	Annexure-1 to QP- A (Type test conduction) 2 (a) Sampling: "Type test to be conducted on one size of cable on every lot of cable".	Type test to be conducted on each type and size of cable, shall be carried out on one sample drum selected on random basis in each lot.
2.	Annexure-1 to QP- B (Acceptance test conduction) 2 Sampling: "Sampling for acceptance test shall be as per Appendix B of IS:1554 part I (control cable).	"Acceptance test (including FRLS & Flammability Test) to be conducted on 1 out 10 drums or less of every size for every lot."
3.	Annexure-1 to QP- B (Routine test conduction).	C.2: Sampling to be added: Routine Test shall be conducted on 100% drum.
4.	Section-II, Clause No.4.1: Cables shall be supplied in non-returnable drums. Material of cable drums shall be wooden.	Shall be read as: "Cables shall be supplied in non-returnable drums, of heavy construction. Material of cable drums shall be wooden."
5.	Section-II, Clause No 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	Shall be read as: "In case of wooden drums, all wooden parts shall be manufactured from seasoned wood. Wooden cable drum shall be treated by immersing in copper-nitrate solution. Drum number shall be indicated on each drum. 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. Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to

	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.	the drum. The ends of each length shall be sealed before shipment. In case of wooden drums, 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. Wooden drums shall comply with IS: 10418." Wood preservative anti-termite treatment shall be applied to the entire drum. BIS certification mark shall be stamped on each cable drum.

4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

4.1 Documents/drawings to be submitted as part of technical offer & after placement of order for BHEL & customer's approval shall be as part of NIT.

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

Sl. No.	Drawing / Document Description	Drawing / Document no	Document Type
1	Technical Data sheet - LT HRPVC Control cables	PE-V0-415-507-E171	Primary
2	Cross-section Drgs.- LT HRPVC Control Cables	PE-V0-415-507-E173	Primary
3	Quality Plan - LT HRPVC Control Cables	PE-V0-415-507-E919	Primary
4	Type test Certificates - LT HR PVC Control Cables	PE-V0-415-507-E174	Secondary

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

Note:

1. The above list of drawings and documents is indicative.
2. After receiving LOI, the vendor shall submit drawings/documents in requisite number of copies as per NIT.

* 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.

	TECHNICAL SPECIFICATION FOR LT HRPVC CONTROL CABLES	SPECIFICATION NO. PE-TS-415-507-E004	
		VOLUME II	
		SECTION I	
		REVISION 0	DATE: 14.10.2021
		SHEET 1 OF 3	

DATA SHEET-A (CONTROL CABLE)

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:1554 (Part-1), IS:8130, IS:5831, IS:10810, IS:3975, ASTMD:2843, ASTMD:2863, ASTM D 3137:81, IEC-60754-1, IEC:60332 Part-1, IEC:60332 Part-3-23
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	**CONDUCTOR**	
(a)	Material	Copper
	Grade and Class	Stranded, annealed high conductivity, Class 2
		Non-Compacted
		Untinned
(b)	Standard Applicable	IS: 8130
(c)	Shape	Circular
(d)	Min. number of strands	7
6.0	**INSULATION**	
(a)	Material	EXTRUDED HRPVC TYPE-C conforming to IS 5831. The minimum volume resistivity of insulation shall be 3.5 x 10^{14} ohm-cm at 27^{o} C and 3.5 x 10^{11} ohm-cm at 85^{o} C.
(b)	Standard Applicable	IS: 5831
(c)	Continuous withstand temperature	85°C
(d)	Short-circuit withstand temperature	160°C
(e)	Method of application	By extrusion; sleeve extrusion not permitted.
(f)	Nominal Thickness of insulation	As per Table-2 of IS: 1554 (Part-1)
7.0	**CORE IDENTIFICATION**	
(a)	Control Cables up to 5 core	Colour coding as per IS 1554 (Part-1)
(b)	Control Cables above 5 cores	By numbering as per IS 1554 (Part-1). Insulation to have black colour.
8.0	**INNER SHEATH**	
(a)	Material	*EXTRUDED HRPVC Type ST-2 OF IS 5831*
(b)	Standard Applicable	IS: 5831
(c)	Colour	*Black (Project specific requirement shall be informed later)*
(d)	Whether FR-LSH Applicable	*YES*
(e)	Thickness of inner sheath	As per Table-4 of IS: 1554 (Part-1)
(f)	Fillers	Acceptable
(g)	Material of fillers (if permitted)	Same as inner sheath i.e. ST2.
(h)	Method of application for multi-core cables:	
(i)	With fillers	*Pressure/Vacuum extruded*
(ii)	Without fillers	*Pressure extruded*

	TECHNICAL SPECIFICATION FOR LT HRPVC CONTROL CABLES	SPECIFICATION NO. PE-TS-415-507-E004
		VOLUME II
		SECTION I
		REVISION 0 / DATE: 14.10.2021
		SHEET 2 OF 3

9.0	**ARMOUR**	
(a)	Applicable	YES
(b)	Material:	Galvanised Steel Round Wire for twin and multicore cable
(c)	Standard Applicable	IS: 1554 (Part-1) Table-5 and IS:3975
(d)	Minimum Coverage	90%
(e)	Gap between armour wires	Shall not exceed one armour wire space (No cross-over/ over-riding)
(f)	Breaking load of joint	95 % of normal armour
10.0	**OUTERSHEATH**	
(a)	Material	EXTRUDED HRPVC, TYPE ST2 OF IS 5831
(b)	Standard Applicable	IS: 1554 (Part-1) & IS: 5831
(c)	Colour	*Black / Grey (Project specific requirement shall be informed later)*
(d)	Whether FR-LSH	*Yes*
(e)	Method of application	Extruded
(f)	Thickness of outer sheath	As per Table-7 of IS: 1554 (Part-1)
(g)	Marking	*A. MARKING ON OUTER SHEATH OF CABLE BY EMBOSSING AT EVERY 5 METER:* *'MSPGCL' and 'BHEL-PEM', Cable size (cross section area and no. of cores) and voltage grade; Letters HRPVC and FRLSH; Manufacturer's name and/ or trade name, and year of manufacture; 'IS Number', ISI MARK.* *B. Non-erasable Progressive sequential length marking at an interval of 1m throughout the Drum Length.*
11.0	**FR-LSH CHARACTERISTICS**	
(a)	*Oxygen index*	*Min 29 (As per IS 1554-I /ASTMD 2863)*
(b)	*Temperature index*	*Min. 250°C(As per IS 1554-I /ASTMD 2863)*
(c)	*Acid gas generation*	*Max. 20% by weight (As per IS 1554-I /IEC-60754-1)*
(d)	*Smoke density rating*	*Max. 60% (As per IS 1554-I /ASTM D 2843)*
(e)	**Flammability Test** (Also refer Note:1,2 & 3)	
(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)	Swedish Chimney test SEN-SS-424-1475-F3	*YES*
12.0	***Anti-rodent and Termite repulsion Test (Refer Note:4)***	*YES*
13.0	**Special Tests**	
(a)	Hydrolytic Stability Test	No (Refer Clause no 3.4 of Section-II).
(b)	Ultraviolet Radiation Test	No (Refer Clause no 3.4 of Section-II).
14.0	**TOLERANCE ON OUTER DIAMETER**	± 2mm
15.0	**MINIMUM BENDING RADIUS**	
(a)	Multi core cables	12 x O.D.

16.0	**SAFE PULLING FORCE**	
(a)	Copper conductor cable	50 N/ sq. mm.
17.0	**CABLE DRUMS**	
(a)	Type of Drum	Wooden as per IS 10418
(b)	Standard drum length	1000m (±) 5%.
(c)	Painting	Entire surface to be painted. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drums shall be treated by immersing in copper-nitrate solution. Drum number shall be indicated on each drum.
(d)	Outermost Layer	To be covered with water-proof polyethylene
(e)	Construction Details	*As per Section-I of this Technical Specification.*
(f)	Particular details on Drum	Both the end of 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 & erection. Wood preservative anti-termite treatment shall be applied to the entire drum.
(g)	Marking (in printed form)	a. MSPGCL b. Manufacturer's Name or trade mark c. Type of Cable and Voltage grade d. Year of Manufacture e. Type of Insulation Eg. HRPVC f. Number of core and size of cables g. Cable Code Eg. FRLSH h. Single length of cable on drum i. Direction of rotation by arrow j. Approx. gross mass k. IS/IEC number l. ISI Mark
(h)	Cable packing	Please refer Clause no 4.2 of Section-II of this technical specification & Section-I 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. (Please refer typical drawing of cable drum packing, attached in section -II)

Note: 1. This test shall generally be carried out as per IEEE 383. The cable installation to be tested shall consist of as many cables as are necessary to give at least 10 kg of organic material per metre run.
2. The following cable installation shall be tested: Installation with single / multi core cables in touching formation.
3. Size of cables, number of cables, number of layers and laying arrangements for each installation shall be subject to BHEL / Customer's approval.
4. Note: A few chipping of the outer sheath 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.

	TECHNICAL SPECIFICATION FOR LT HRPVC CONTROL CABLES	SPECIFICATION NO. PE-TS-415-507-E004	
		VOLUME II	
		SECTION	
		REVISION 0	DATE: 14.10.2021
		SHEET 1 OF 3	

DATA SHEET C

GUARANTEED TECHNICAL PARTICULARS
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

S NO.	PARTICULARS	
1	Name of manufacturer	
2	Place of manufacture	
3	No of cores X Nominal area of conductor (mm2)	
4	Cable Type	
5	**CONDUCTOR**	
	a) Material type & grade	
	b) Shape	
	c) No. of Strands/Diameter of each strand (No. / mm)	
6	**HRPVC INSULATION**	
	a) Material	
	b) Dielectric strength kv/mm	
	c) Nominal thickness (mm)	
	d) Volume resistivity at 27° C (ohm-cm)	
	e) Volume resistivity at 70° C (ohm-cm)	
	f) Insulation resistance constant at 27° C (M ohm km)	
	g) Insulation resistance constant at 70° C (M ohm km)	
	h) Min. Tensile strength (N/mm2)	
	i) Min. Elongation at break (%)	
	j) Negative tolerance on thickness (mm)	
	k) Fictitious dia over insulation (mm)	
7	**FILLERS**	
	a) Material	
8	**INNERSHEATH**	
	a) Material	
	b) Whether FRLS	
	c) Minimum thickness (mm)	
	d) Colour of inner sheath	
	e) Fictitious dia over inner sheath (mm)	

	TECHNICAL SPECIFICATION FOR LT HRPVC CONTROL CABLES	SPECIFICATION NO. PE-TS-415-507-E004	
		VOLUME II	
		SECTION	
		REVISION 0	DATE: 14.10.2021
		SHEET 2 OF 3	

9	**ARMOUR**	
	a) Material	
	b) Type of armouring	
	c) Nominal size of armour (mm)	
	d) Minimum coverage	
	e) Method of jointing	
	f) Breaking load of joint	
	g) Minimum no. of wires (No.)	
	h) Armour resistance at 20 deg.C (Ohm/km) max	
	i) Max. Resistivity of GS wire (Ohm-cm) max.	
	j) Fictitious dia over Armouring (mm)	
10	**OUTERSHEATH**	
	a) Material	
	b) Whether FRLS	
	c) Thickness (mm) (Nominal)	
	d) Min. Tensile strength (N/mm2)	
	e) Min. Elongation at break (%)	
	f) Colour of Outer sheath	
	g) Tolerance on thickness in mm	
11	Permissible Voltage Variation	
12	Permissible Frequency Variation	
13	Combined Voltage & Frequency Variation	
14	Max. rated Conductor temperature	
15	Max. allowable conductor temperature during short circuit	
16	a. Continuous current carrying capacities	
	b. In Ground 30 deg.C (A)	
	c. In Duct 30 deg.C (A)	
	d. In Air 50 deg.C (A)	
	e. Depth of laying	
	f. Thermal resistivity of soil	
17	**FRLS PROPERTIES**	
	a. Oxygen Index (ASTMD 2863)	
	b. Temperature Index (ASTMD 2863-77)	
	c. Smoke density rating (ASTMD 2843)	
	d. HCL (ACID) Gas Generation (IEC 754-1)	
	e. Flammability tests	

	TECHNICAL SPECIFICATION FOR LT HRPVC CONTROL CABLES	SPECIFICATION NO. PE-TS-415-507-E004	
		VOLUME II	
		SECTION	
		REVISION 0	DATE: 14.10.2021
		SHEET 3 OF 3	

18	**CABLE DRUMS**	
	a. Type & construction	
	b. Stranded drum length with tolerance on drum length	
19	Max. D.C. resistance of conductor at 20° C- Main (ohm/km)	
20	Max. A.C. resistance of conductor at 70° C- Main (ohm/km)	
21	Calculated star reactance (ohm/km)	
22	Approx. Cable Capacitance (micro F/km)	
23	Charging current at 415 V (A/km)	
24	Loss tangent (for reference only)	
25	**DIAMETERS**	
	a. Approx. dia over insulation (mm)	
	b. Approx. dia over inner sheath (mm)	
	c. Fictitious. dia under outer sheath (mm)	
	d. Approx. overall dia of cable (mm)	
	e. Tolerance on overall dia in mm	
26	Minimum bending radius	
27	safe pulling force when pulled by pulling eye N	
28	Approximate weight of cable (kg/km)	
29	Marking at every 5 meter on Outer Sheath by Embossing	
30	Marking at every 1 meter on Outer Sheath by Printing	

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 HRPVC Control 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 HRPVC Control 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-E003, Rev-1) as attached with the specification without any deviations. At contract stage, the successful bidder shall submit the same QP for BHEL/ ultimate customer's approval. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ultimate customer's approval. There shall be no commercial implication to BHEL on account of minor changes in QP during contract stage.

3.2 All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved Quality Plan.

3.3 Type testing, 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.

	TECHNICAL SPECIFICATION FOR LT HRPVC CONTROL CABLES	SPECIFICATION NO. PE-TS-415-507-E004	
		VOLUME II	
		SECTION II	
		REVISION 0	DATE: 14.10.2021
		Sheet 2 of 2	

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 : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 1 OF 17

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	D	**			
					M	C/N					M	C	N	
RAW MATERIAL														
Copper Rods	**GENERAL:**													
	1. Physical properties	MA	Physical Tests	Sample/Batch	Sample /Batch		IS 613	IS 613	Test Certificate	√	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	COC	√	P	V	-	
	b) Grade	MA	-do-	-do-	-do-		IS 613	IS 613	Test Certificate	√	P	V	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI		
Reviewed by:	28/2/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. 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 : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 2 OF 17

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	D	**			
					M	C/N					M	C	N	
		c) Resistivity	MA	Electrical Tests	Manufacturer std.	Manufacturer std.	IS 613	IS 613	Test Certificate	√	P	V	-	
	PVC Compound (for insulation)	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/Batch	Sample/Batch	IS 5831	IS 5831	Test Certificate	√	P/V	V	-	
		2. Elec.Properties	MA	Electrical Tests	Sample/Batch	Sample/Batch	-do-	-do-	-do-	√	P/V	V	-	
		SPECIFIC CHECKS:												

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI		
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/21 28/2/2020	R.K. 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 : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET3 OF [illegible]

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC	√	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	-	
	Fillers (as applicable)	1. Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC	√	P	V	-	Fillers material chosen shall be compatible with the temperature rating of the cable and shall have no deleterious effect on any other component of cable)
		2. Flame retardant & moisture resistant. (as applicable)	CR	Chemical/ Environ.	-do-	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P/ V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	29/2/2020	R.K. JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 4 OF 17

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	D	**			
					M	C/N					M	C	N	
	Galvanised steel wire/strip for Armour (if applicable)	**GENERAL :**												
		1. Make	MA	Verify	Manufacturer std.	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Inspection report/ Test Certificate	√	P	V	-	
		2. Dimension	MA	Measurement	-do-	-	Approved datasheet	Approved datasheet	-do-	√	P/ V	-	-	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	-	-do-	-do-	-do-	√	P/ V	-	-	* Sample from each armour size/Batch/ Lot
		4.Galvanization Quality	MA	Galv.Tests	-do-	-	IS 3975	IS 3975	-do-	√	P/ V	-	-	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	Devendra Singh 28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI		
Reviewed by:	Manish 28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. 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 : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 5 OF 17

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	
	PVC compound for Sheath	**GENERAL :**												
		1. Physical properties	MA	Physical Tests	Sample/Batch	Sample/Batch	IS 5831	IS 5831	Inspection report/ Test Certificate	√	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:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI		
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. 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 : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 6 OF 17

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	D	**			
					M	C/N					M	C	N	
		a) Make	MA	Verify	100%	100%	Manufacturer approved source	Manufacturer approved source	COC	√	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	-	
	Wooden drums	1. Phy. & Constructional checks	MA	Visual	Mfr's Plant Std.	Mfr's Plant Std.	IS 10418	IS 10418	Inspection report/ Test Certificate	√	P	V	-	
		2. Anti-termite treatment	MA	Chem.	-do-	-do-	Mfr's Plant Std.	Mfr's Plant Std.	COC	√	P	V	-	

534383/2021/PS-PEM-EL

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	28.02.2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 7 OF 17

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	
	Steel drums (If applicable)	1. Dimension	MA	Meas.	Mfr's Plant Std.	Mfr's Plant Std.	Approved drawing of steel drum	Approved drawing of steel drum	Inspection report	√	P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	Surface shall be smooth	Surface shall be smooth	Inspection report	√	P	V	-	
	IN PROCESS													
	Wire Drawing & Annealing	1. Size	MA	Dimensional	Mfr's Plant Std.	Mfr's Plant Std.	Approved Data Sheet	Approved Data Sheet	Inspection report	√	P	V	-	
		2. Surface finish	MA	Visual	-do-	-do-	Surface shall be smooth	Surface shall be smooth	-do-	√	P	V	-	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 8 OF 17

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 1554 Pt-1./ IS 8130 & Approved Data Sheet	IS 1554 Pt-1./ IS 8130 & Approved Data Sheet	-do-	√	P	V	-	
	Tinning (Conductor)	1. Size	MA	Dimensional	Plant Mfg. Std.	Plant Mfg. Std.	Mfrs Std	Mfrs Std	-do-	√	P	V	-	(Applicable only for tin-coated copper conductor)
		2. Chemical test for tinning	CR	Chemical	-do-	-do-	IS 10810 Pt-4	IS:8130	-do-	√	P	V	-	
	Stranding of wires	1. No.of wires	MA	Counting	Mfr's Plant Std.	Mfr's Plant Std.	Approved Data Sheet	Approved Data Sheet	-do-	√	P	V	-	
		2. Resistance	CR	Electrical	-do-	-	-do-	-do-	-do-	√	P	-	-	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	28.02.2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 9 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		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. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	
	Core Insulation (No repair permitted)	1. Surface finish	MA	Visual	100%	100%	Free from bulging	Free from bulging	Inspection report	√	P	V	-	
		2 Insulation thickness	CR	Measurement	one Sample of each	-	Appd.data sheet	Appd.data sheet	-do-	√	P	-	-	

534383/2021/PS-PEM-EL

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI		
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. 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 : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 10 OF 17

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	
					size/lot									
		3. Concentricity #	CR	Measurement	-do-	-do-	Mfrs Std	Mfrs Std	Inspection Report	√	P	V	-	# To be checked at starting & finish end of Extruded Length
		4 Dia over insulation	MA	Measurement	-do-	-	Approved Data Sheet	Approved Data Sheet	-do-	√	P	-	-	
		5. Core identification	MA	Visual	100%	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	
		6. TS & % Elongation	MA	Mechanical	100%	-	IS 1554 Pt-1/ IS 5831	IS 1554 Pt-1/ IS 5831	-do-	√	P	-	-	

534383/2021/PS-PEM-EL

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	Devendra 28-02-2020	DEVENDRA SINGH	Checked by:	Kunal 28/2/2020	KUNAL GANDHI		
Reviewed by:	Manish 28/02/2020	MANISH SHUKLA	Reviewed by:	R.K. 28/2/2020	R.K. 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 : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 11 OF 17

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	
		7. Spark Test or Water immersion test	CR	Electrical	100%	-	Mfr's Std.	Mfr's Std.	-do-	√	P	-	-	
	Core laying	1. Dia over laid up core	MA	Measurement	one Sample of each size/lot	-	Approved Data Sheet	Approved Data Sheet	-do-	√	P	-	-	
		2. Sequence of lay and lay length & direction for laid up core	MA	Visual meas	one Sample of each size/lot	-	IS 1554 Pt-1	IS 1554 Pt-	-do-	√	P	-	-	
		3.Core identification	CR	Visual	one Sample of each size/lot	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	Devendra Singh 28-02-2020	DEVENDRA SINGH	Checked by:	Kunal Gandhi 28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	Manish 28/02/2020	MANISH SHUKLA	Reviewed by:	R.K. Jaiswal 28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 12 OF 17

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	D	M	C	N	
					M	C/N					**			
	Inner Sheath Extrusion (if applicable)	1. Surface finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	-do-	√	P	-	-	
		2. Sheath thickness	CR	Measurement	One sample of each size/lot	-	Approved Data Sheet	Approved Data Sheet	-do-	√	P	-	-	
		3.Dia over inner sheath	MA	Measurement	-do-	-	Approved Data Sheet	Approved Data Sheet	-do-	√	P	-	-	
	Armouring (if applicable)	1. No.of wires/Strips	MA	Counting	At the start of the process	-	Mftr's Std	Mftr's Std	-do-	√	P	-	-	
		2. Lay Direction	MA	Visual	-do-	-	IS 1554 Pt-1	IS 1554 Pt-1	-do-	√	P	-	-	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	20-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 13 OF 17

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	D	**			
					M	C/N					M	C	N	
		3. Lay Length	MA	Visual, Meas.	At the start of the process	-	IS 1554 Pt-1	IS 1554 Pt-1	-do-	√	P	-	-	
		4. Coverage	MA	Measurement	-do-	-	Approved data sheet	Approved data sheet	-do-	√	P	-	-	
		5. Dia over armouring	MA	Measurement	-do-	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	
	Outer Sheath Extrusion	1. Surface Finish	MA	Visual	100%	-	Surface shall be smooth	Surface shall be smooth	-do-	√	P	-	-	
		2.Sheath thickness	CR	Measurement	One sample of each size/lot	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 14 OF 17

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	D	**			
					M	C/N					M	C	N	
		3. Dia over outer sheath	MA	Measurement	One sample of ech size/lot	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	
		4. Marking/ Colour / Embossing	MA	Visual	One sample of ech size/lot	-	Appd. Data Sheet	Appd. Data Sheet	-do-	√	P	-	-	
	Final Inspection (Internal)	1.Routine Test (Refer Note-H)	CR	Electrical Test & measurement	100%	100%	IS 1554-I & Appd. Datasheet	IS 1554-I & Appd. Datasheet	Test Report	√	P	V	√	#: Refer Annexure-A to QP
	Final Inspection	1. Finish	MA	Visual, Measurement	See Remark	See Remark	IS 1554 Pt-1/ Appd. Data Sheet	Free from Bulging, Burnt particles, lumps, cuts & scratches/ Approved data sheet	Test Report	√	P	W	W	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI		
Reviewed by:	Manish 28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. 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 : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 15 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	**			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9					
		2. Length	MA	Visual, Measurement	See Remark	See Remark	IS 1554 Pt-1/ Appd. Data Sheet	BHEL Spec./ Data Sheet	Test Report	√	P	W	W	
		2. Dimensions	MA	Measurement	As per IS	As per IS	IS 1554 Pt-1/ Appd. Data Sheet	Appd. Data sheet	Test Report	√	P	W	W	
		3. Armouring - Coverage No.of Wires/Strips	MA	Visual & Meas.	-do-	-do-	IS 1554 Pt-1/ Appd. Data Sheet	IS 1554 Pt-1/ Appd. Data Sheet	Test Report	√	P	W	W	'Refer Annexure-I to QP for sampling plan.
		4. Marking/Colour Coding	MA	Visual	-do-	-do-	IS 1554 Pt-1/ Appd. Data Sheet	IS 1554 Pt-1/ Appd. Data Sheet	Test Report	√	P	W	W	
		6. Acceptance Tests (Refer Note-H)	CR	Phy & Elect. Tests FRLS Test	Sample #	Sample #	#:	#:	Test Report	√	P	W	W	

BHEL						BIDDER/ SUPPLIER	
ENGINEERING			QUALITY			Sign & Date	
	Sign & Date	Name		Sign & Date	Name	Seal	
Prepared by:	Devendra Singh 28-02-2020	DEVENDRA SINGH	Checked by:	Kunal Gandhi 28/2/20	KUNAL GANDHI		
Reviewed by:	Manish 28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. 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 : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 16 OF 17

Sl. No.	COMPONENTS & OPERATIONS	CHARACTERSTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
					M	C/N				D	M	C	N	
1	2	3	4	5	6		7	8	9		**			
		7. Type & FRLS Tests (Refer Note-H)	CR	Measurement	sample	sample	#:	#:	Test Report	√	P	W	W	
	Packing	Sealing Identification	MA	Visual	100%	100%	As per IS	As per IS	Test Report	√	P	W	-	

NOTES: -	
(A)	JOINTS IN WIRE SHALL BE AS PERMITTED BY MFRS STANDARD. VENDOR TO CERTIFY THE SAME.
(B)	NO REPAIR OF CORE INSULATION PERMITTED
(C)	CABLE ENDS SHALL BE SEALED AS PER VENDOR'S SPECIFICATION.
(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 APPROVED DATA SHEET
(F)	WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS 'SAMPLE' & NOT DEFINED IN QP, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN.
(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.

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:	28/02/2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI			Reviewed by:			
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL			Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO : PE-RC-999-507-E004	DATE:
	CUSTOMER :		QP NO.: PE-QP-999-507-E003, R-1	DATE:
	PROJECT:		PO NO.:	DATE:
	ITEM: 1.LT PVC CONTROL CABLE 2.LT HR PVC CONTRL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	SYSTEM:	SECTION: II	SHEET 17 OF 17

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

(I)	BHEL RESERVES THE RIGHT FOR CONDUCTING REPEAT TEST, IF REQUIRED.
(J)	AFTER PACKING AND PRIOR TO ISSUE OF MDCC, PHOTOGRAPHS OF COMPLETE CABLE (TO BE DISPATCHED) SHALL BE SENT TO BHEL-PURCHASE GROUP FOR REVIEW.
(K)	PROJECT SPECIFIC QP SHALL BE DEVELOPED BESED ON CUSTOMER REQUIREMENT.

LEGENDS:

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

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

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

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

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	28-02-2020	DEVENDRA SINGH	Checked by:	28/2/2020	KUNAL GANDHI
Reviewed by:	28/02/2020	MANISH SHUKLA	Reviewed by:	28/2/2020	R.K. JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

534383/2021/PS-PEM-EL

	ANNEXURE-I TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER: PE-RC-999-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E003, R1	SPECIFICATION TITLE:
		SYSTEM	ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	DOC. NO.

TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS

A. Type Test Conduction:

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

2. Sampling:
   a) Type test to be conducted on one size of cable for every lot of cable.
   b) FRLS & 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:
   Sampling for acceptance tests shall be as per Appendix-B of IS: 1554 Part-I (control cable).

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

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.

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

NOTE

LOT shall be defined as per IS: 1554 Part-I (control cable).

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	**Tests for Conductor**				
I.	Annealing test	For copper conductor	**T, A**	IS 10810 Pt 1	*In process records shall be furnished to inspector at the time of inspection.*
II.	Resistance test	For copper conductor	**T, A, R**	IS 10810 Pt 5	
2.0	**Tests for Armour Wires/Strips**				
I.	Measurement of dimensions	Applicable for GS wire/Strip	**T,A**	IS 10810 Pt 36	
II.	Tensile test	Applicable for GS wire/Strip	**T, A**	IS 10810 Pt 37	

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		DEVENDRA SINGH	Checked by:		KUNAL GANDHI			Reviewed by:			
Reviewed by:		MANISH SHUKLA	Reviewed by:		R.K. JAISWAL			Approved [illegible]			

534383/2021/PS-PEM-EL

BHEL	ANNEXURE-I TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER: PE-RC-999-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E003, R1	SPECIFICATION TITLE:
		SYSTEM	ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
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 GS wire/Strip	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 G. S. wires/Strip only	A	IS 10810 Pt 3	
3.0	**Physical Tests for PVC Insulation & PVC sheath**				
I.	Test for thickness	Applicable for PVC insulation, PVC inner sheath & PVC outer sheath	T, A	IS 10810 Pt 6	
II.	Tensile strength and elongation test at break	Applicable for PVC 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 PVC insulation & PVC outer sheath	T	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 10	
V.	Hot deformation test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 15	
VI.	Heat shock test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 14	
VII.	Shrinkage test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 12	
VIII.	Thermal stability test	Applicable for PVC insulation & PVC outer sheath	T	IS 10810 Pt 60	
4.0	**Improved Fire performance (FR-LSH) Tests**				
I.	Oxygen index test	For PVC outer sheath only	T, A	IS 10810 Pt 58 / ASTMD 2863	**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	IS 10810 Pt 64 / ASTMD 2863	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	28.12.21	DEVENDRA SINGH	Checked by:	28/12/21	KUNAL GANDHI
Reviewed		MANISH	Reviewed by:		R.K.

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

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

534383/2021/PS-PEM-EL

	ANNEXURE-I TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER: PE-RC-999-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E003, R1	SPECIFICATION TITLE:
		SYSTEM	ITEM: 1. LT PVC CONTROL CABLE 2. LT HRPVC CONTROL CABLE 3. LT PVC POWER CABLE 4. LT HRPVC POWER CABLE	DOC. NO.

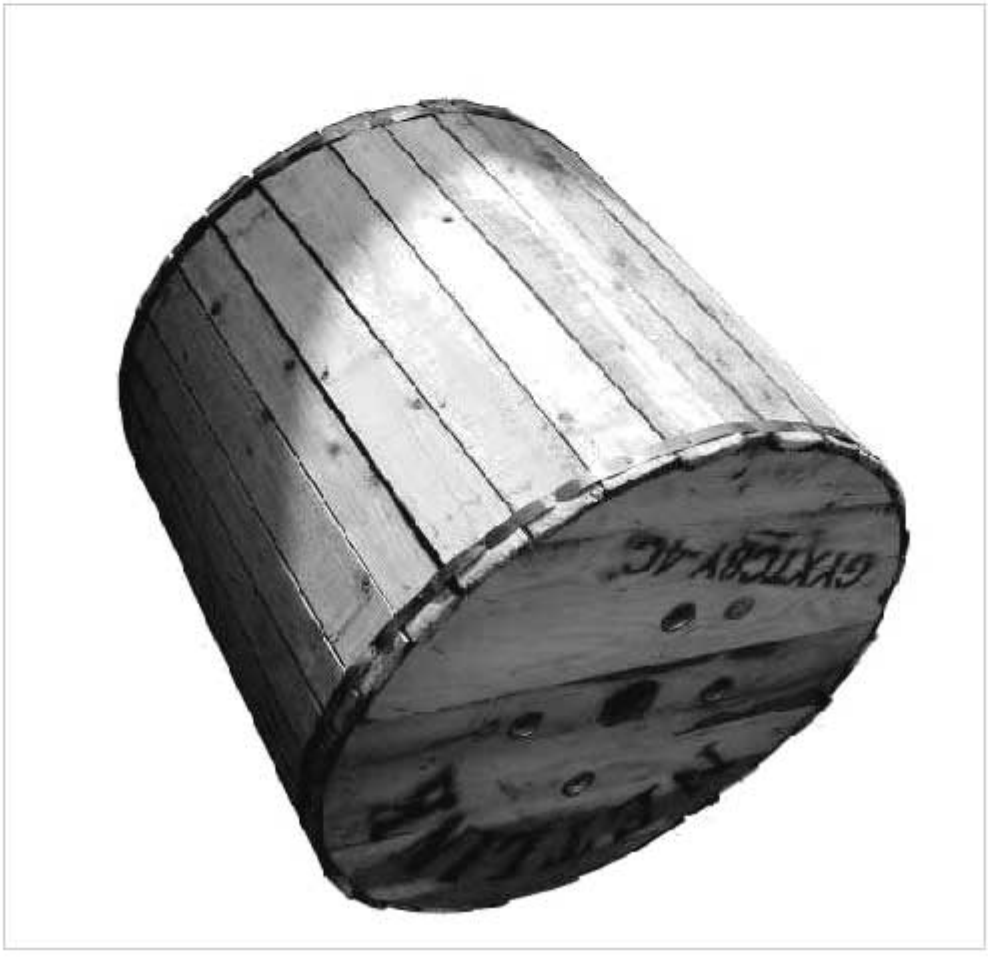
S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
5.0	**Flammability Tests**				
I.	Flammability test for bunched cables	For complete cable	T	IS 10810 Pt 62/ IEC-60332 (Part-3-23-Cat-B)	**Test & Category applicable as indicated in Datasheet-A**
II.	Flammability test for 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 (Water immersion test)	On cores	T	IS 10810 Pt 45	
II.	High Voltage Test at room temperature	For complete cable	T, A, R	IS 10810 Pt 45	
III.	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	**Test applicable if indicated in Datasheet-A**
8.0	**Anti-Fungal Test**	For PVC outer sheath only	A	--	
9.0	**Special Tests**				
I.	Hydrolytic Stability Test	For complete cable	**	ASTM D 3137:81	**Test applicable if indicated in Datasheet-A**
II.	Ultraviolet Radiation Test	For complete cable	**	BS EN ISO 4892-2	

***** These tests shall be conducted on one sample for the entire contract and duration of these tests shall be 14 days.***

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.

BHEL						BIDDER/ SUPPLIER		FOR CUSTOMER REVIEW & APPROVAL			
ENGINEERING			QUALITY			Sign & Date		Doc No:			
	Sign & Date	Name		Sign & Date	Name	Seal			Sign & Date	Name	Seal
Prepared by:		DEVENDRA SINGH	Checked by:		KUNAL GANDHI			Reviewed by:			
Reviewed by:		MANISH SHUKLA	Reviewed by:		R.K. JAISWAL			Approved by:			

TYPICAL DRAWING OF CABLE DRUM PACKING



534383/2021/PS-PEM-EL

BHEL	**PRE-QUALIFICATION REQUIRMENTS FOR LT HRPVC FRLS CONTROL CABLE**	PE-PQ-999-507-E020 REVISION NO. 1 DATE 28/03/2018 SHEET NO. 1 OF 1

ITEMS : LT HRPVC Control Cable

SCOPE : Supply : YES; Erection & Commissioning : NO;

1.0	Vendor should be a manufacturer of LT control cables.
2.0	Availability of test reports of tests of LT PVC/HRPVC FRLS control 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).
3.0	Capacity of manufacturing 200 km of LT control cables per month.
4.0	Manufactured and supplied at least one (1) km of FRLS cables.
5.0	Manufactured and supplied LT control cables upto 12 cores.
6.0	Manufactured & supplied at least 500 km of LT control cables of min. 1.5 sq. mm..in one or more orders and at least 100 km of LT control cables of min. 1.5 sq. mm. in one single order.
7.0	Minimum two (2) nos. purchase orders for LT PVC/HRPVC control cables shall be submitted which should not be more than five (5) years old from the date of application for registration or date of techno- com mercial bid opening (as applicable) for establishing continuity in business.

Notes (General points):

1. Consideration of offer shall be subject to customer's approval of bidders, 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. Any other project specific requirement shall be as per Annexure-I and bidder shall submit relevant supporting documents. Bidder to meet criteria as stated above and as per Annexure- I

4. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.

5. After satisfactory fulfillment of all the above criteria/ requirement, offer shall be considered for further evaluation as per NIT and all the other terms of the tender.

PREPARED BY	REVIEWED BY	APPROVED BY
28/03/18 ABHISHEK, MANAGER (CONVENOR)	28/03/18 MANISH SHUKLA, DGM (APPROVER)	28/3/18 RAJNISH GOYAL, AGM (DH)

ANNEXURE – I

PROJECT SPECIFIC CRITERIA AGAINST ENQUIRY

PROJECT: 1x660MW BHUSAWAL TPS

1. Bidder should have supplied/provided LT HRPVC Control Cable for at least one thermal power plant of 500MW or above capacity which has completed one year of commercial operation and the equipment supplied should have completed the contractual guarantee period or should have supplied LT HRPVC Control Cable of rating/type/size as required under the contract to any power plant.

2. Bidder should have manufactured & supplied LT HRPVC Control Cable similar to as being supplied in this project, which shall be in successful operation for similar duty condition and similar application for minimum one (1) year as on 06.08.2018.

3. In support of above criteria, along with bid, bidder to submit credentials for scrutiny & approval.

4. In case of any conflict of project specific PQR with main PQR, vendor to furnish document meeting the stringent requirement between the main PQR and project specific PQR.

Sourabh Tiwari
Digitally signed by Sourabh Tiwari
DN: cn=Sourabh Tiwari, o=BHEL, ou=Electrical, email=sourabhtiwari@bhel.in, c=IN
Date: 2021.10.13 10:35:25 +05'30'

Sourabh Tiwari
[Manager]

Amitpal Singh
Digitally signed by Amitpal Singh
DN: cn=Amitpal Singh, o=BHEL, ou, email=amitpalsingh@bhel.in, c=IN
Date: 2021.10.14 09:15:17 +05'30'

Amitpal Singh
[Sr. Manager]

okumar
Digitally signed by okumar
DN: cn=okumar, o=bhel, ou=bhel, email=okumar@bhel.in, c=IN
Date: 2021.10.14 16:14:49 +05'30'

Omkar Kumar
[Section Head]

DEBASISA RATH

Debasisa Rath
[DH-Electrical]

1 X 660 MW BHUSAWAL TPS
ANNEXURE-A

BILL OF QUANTITIES (1.1kV LT HRPVC CONTROL CABLES)

(A) MAIN SUPPLY

1.1 kV /Copper Conductor/ HRPVC Insulated/ Inner Sheath HRPVC type ST2 / Outersheath HRPVC type ST2 / Outer sheath with FRLSH properties / Round Wire Armoured Cable

S.No.	Item code	Item name	UOM	Ordered Quantity	Drum Length
A1	507-37021-A	**5C-2.5-ARMOURED**	MTR	86000	1000
A2	507-37031-A	**7C-2.5-ARMOURED**	MTR	25000	1000
A3	507-37003-A	**12C-2.5-ARMOURED**	MTR	22000	1000
A4	507-37023-A	**5C-4-ARMOURED**	MTR	15000	1000
A5	507-37043-A	9C-2.5-ARMOURED	MTR	12000	1000

1 Quantities indicated above for S.No. (A) shall be known as Order Quantities. The total quanity variation shall be as per NIT.

2 The bidder shall indicate the unit price of each type and size of cables listed as per the BOQ-Cum-Price Schedule. The unit prices shall apply for adjustment of variation in quantity as stipulated above.

3 Ordered quantities 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 shall be cleared for manufacture based on progress of engineering & site requirements.

4 The standard drum length shall be 1000 meters as indicated above. Tolerance on individual drum length shall be ±5%.

5 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 of 1000m, in which case it shall be -5%/0%. Cables consumed for testing and inspection shall be to bidder's account.

6 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 (except where the total ordered quantity is one single drum length of 1000m). The overall tolerance limits stipulated above shall continue to apply (in case short lengths are accepted).

7 In case of the quantities of any one lot 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.

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

Sourabh Tiwari
Digitally signed by Sourabh Tiwari
DN: cn=Sourabh Tiwari, o=BHEL, ou=Electrical, email=sourabhtiwari@bhel.in, c=IN
Date: 2021.11.05 11:52:04 +05'30'

KANHAIYA KUMAR
Digitally signed by KANHAIYA KUMAR
DN: cn=KANHAIYA KUMAR, o=BHEL, ou=PEM, email=kanhaiya.kumar@bhel.in, c=IN
Date: 2021.11.05 11:55:48 +05'30'

okumar
Digitally signed by okumar
DN: cn=okumar, o=bhel, ou=bhel, email=okumar@bhel.in, c=IN
Date: 2021.11.05 14:12:45 +05'30'

ANNEXURE-B

BILL OF QUANTITIES (1.1kV LT HRPVC CONTROL CABLES)

(B) MANDATORY SPARES

1.1 kV /Copper Conductor/ HRPVC Insulated/ Inner Sheath HRPVC type ST2 / Outersheath HRPVC type ST2 / Outer sheath with FRLSH properties / Round Wire Armoured Cable

S.No.	Item code	Item name	UOM	Ordered Quantity	Drum Length
1	507-37000-B	5C-2.5-ARMOURED	MTR	5000	1000
2		7C-2.5-ARMOURED	MTR	2000	1000
3		12C-2.5-ARMOURED	MTR	1000	1000
4		5C-4-ARMOURED	MTR	1000	1000
5		9C-2.5-ARMOURED	MTR	1000	1000

Notes: (Applicable for Mandatory Spares only)

1. Quantities indicated above for Sl. NO. (B) shall be known as Order Quantities. The total quanity variation shall be as per NIT.

2. The bidder shall indicate the unit price of each type and size of cables listed as per the BOQ-Cum-Price Schedule. The unit prices shall apply for adjustment of variation in quantity as stipulated above.

3 . Tolerance on individual drum length shall be ±5%. Overall tolerance on total dispatched quantity of each size shall be (-) 2% and (+) 0%.

4. Quantity of mandatory spares indicated above shall be manufactured by the successful bidder only after approval from BHEL. The drums supplied against item B shall be clearly identified as "MANDATORY SPARE".

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

Sourabh Tiwari
Digitally signed by Sourabh Tiwari
DN: cn=Sourabh Tiwari, o=BHEL, ou=Electrical, email=sourabhtiwari@bhel.in, c=IN
Date: 2021.11.05 11:52:25 +05'30'

KANHAIYA KUMAR
Digitally signed by KANHAIYA KUMAR
DN: cn=KANHAIYA KUMAR, o=BHEL, ou=PEM, email=kanhaiya.kumar@bhel.in, c=IN
Date: 2021.11.05 11:56:12 +05'30'

okumar
Digitally signed by okumar
DN: cn=okumar, o=bhel, ou=bhel, email=okumar@bhel.in, c=bhl
Date: 2021.11.05 14:13:13 +05'30'

Price Variation Formulae for cables -Annexure-I

1. Prices shall be variable as per price variation formulae given below (basis IEEMA).
The price variation shall be limited to + 20% of total ex-works price actually supplied (cable size wise) and -ve price variation shall be unlimited. Rates for working out price variation shall be as per rates published by IEEMA for the factors given in Annexure-II

2. **Base date for prices:**

Initial Price (As per IEEMA) for-Alo, Cuo, CCo, PVCCo & Feo:
Base Date shall be- 1st working day of the previous month to the date of issue of tender enquiry.

Final Price (as per IEEMA) for- Al, Cu, Cc, PVCC & Fe:
1st working day of month, one month prior to the date on which cable is notified as being ready for inspection i.e TPIA inspection call raise date on web portal.

3. Variation factor value for ALF, CuF, CCFAL, CCFCu, XLFAL, XLFCu, FeF & FeW as applicable shall be as per Technical Specification.

4. PVC shall be payable within contractual delivery period (including any extension thereto).

Vikas
15.01.19

VIKAS KUMAR SINGH
E3 – ELECTRICAL

15/01/19.

Manish Shukla
15/01/19.

IEEMA table for Price variation cause for various type of cable

1. Aluminium conductor cable

S.No	Cable Type	AIF (Single core unarmoured & Multi core armoured)	AIF (Single core armoured)	CCFAI	XLFAL (Single core)	XLFAL (Multi core)	FeF	FeW	IEEMA Formula
1.	HT XLPE Power cable	ALP	H1	H2	XL3	XL4	H3	H5	P=Po+AIF(AL-Alo) + XLFAL(CC-CCo) +CCFAI(PVCC-PVCCo) + FeF(Fe-Feo)
2.	LT XLPE Power Cable	ALP	P1	L2	XL1	XL1	P3	P3 (Additional)	P=Po+AIF(AL-Alo) + XLFAL(CC-CCo) +CCFAI(PVCC-PVCCo) + FeF(Fe-Feo)
3.	LT PVC Power Cable	ALP	P1	P2	-	-	P3	P3 (Additional)	P=Po+AIF(AL-Alo) + CCFAI(PVCC-PVCCo) + FeF(Fe-Feo)
4.	LT HRPVC Power Cable	ALP	P1	P2	-	-	P3	P3 (Additional)	P=Po+AIF(AL-Alo) + CCFAI(PVCC-PVCCo) + FeF(Fe-Feo)

2. Copper conductor cable

S no.	Cable type	CuF	AIF (single core armoured)	CCFCu	XLFCU (Single core)	XLFCU (Multi core)	FeF	FeW	IEEMA Formula
I	HT XLPE Power cable	CUP	H4	H2	XL3	XL4	H3	H5	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) +CCFCu(PVCC-PVCCo) + FeF(Fe-Feo) + AlF(AL-Alo)
2	LT XLPE Power Cable	CUP	P4	L2	XL1	XL1	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo) + AlF(AL-Alo)

02

S no.	Cable type	CuF	AIF (single core armoured)	CCFCu	XLFCU (Single core)	XLFCU (Multi core)	FeF	FeW	IEEMA Formula
3	LT PVC Power Cable	CUP	P4	P2	--	--	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo) + AlF(AL-Alo)
4	LT HRPVC Power Cable	CUP	P4	P2	--	--	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo) + AlF(AL-Alo)
5	LT XLPE Control Cable	CUC	--	P5	--	XL2	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
6	LT PVC Control Cable	CUC	--	P5	--	--	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
7	LT HRPVC Control Cable	CUC	--	P5	--	--	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu(PVCC-PVCCo) + FeF(Fe-Feo)
8	LT XLPE Fire Survival Power Cable	CUP	P4	L2	XL1	XL1	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo))+ AlF(AL-Alo)
9	LT XLPE Fire Survival Control	CUC	--	P5	--	XL2	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
10	LT EPR Fire Survival Power Cable	CUP	P4	L2	--	--	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo))+ AlF(AL-Alo)
11	LT EPR Fire Survival Control cable	CUC	--	P5	--	--	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
12	Screened control Cable (Overall screen)	Cu POS	--	--	--	--	Fe POS	Fe POS	P=Po+CuF(Cu-Cuo) + FeF(Fe-Feo)
13	Screened control Cable (Individual	Cu PIS	--	--	--	--	Fe PIS	Fe PIS	P=Po+CuF(Cu-Cuo) + FeF(Fe-Feo)

03

Annexure-II

IEEMA *Table* for Price Variation Clause for various types of Cables

Notes:-

(i) Cu POS, Cu PIS, Fe POS & Fe PIS tables shall be as per IEEMA circular No. IIEMA (PVC) /Instrumentation Cable/2014 effective from dtd 01.07.2014.

(ii) All other tables shall be as per IEEMA circular No. 35//DIV/CAB/05/ dated 24.04.2018.

Terms used in PVC formulae:

P = Price payable as adjusted in accordance with above appropriate formula (In Rs./Km).
Po= Price quoted/confined (in Rs./km).

1. ALUMINIUM
ALF Variation factor for aluminium.
Al =Price of aluminium.
Alo = Price of aluminium.

2 COPPER
CuF =Variation factor for copper.
Cu = Price of CC copper rods.
Cuo = Price of CC copper rods.

3.PVCc COMPOUND/POLYMER
PVCc = Price of PVC compound.
PVCco= Price of PVC compound.
CCFAL= Variation factor for PVC compound/Polymer for aluminium conductor cable.
CCFCu =Variation factor for PVC compound/Polymer for copper conductor cable.

4. XLPE COMPOUND
Cc = Price of XLPE compound.
Cco= Price of XLPE compound.
XLFAL= Variation factor for XLPE compound for aluminium conductor cable.
XLFCu =Variation factor for XLPE compound for copper conductor cable.

5.STEEL
Fe= Price of steel strips/steel wire.
Feo= Price of steel strips/steel wire.
FeF =Variation factor for steel.
FeW=Variation factor for round wire steel armouring.

5

ieema
your link to electricity

501, Kakad Chambers
132, Dr. Annie Besant Road, Worli
Mumbai 400018
India

P: +91 22 2493 0532
F: +91 22 2493 2705
E: mumbai@ieema.org
www.ieema.org

IEEMA (PVC)/Instrumentation Cable/2014 **Effective from: 1st July 2014**

Material Price Variation Clause For Instrumentation 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 Price quoted/confirmed **(in Rs/Km)**

COPPER

CuF Variation factor for copper

Cu Price of CC copper rods. This price is as applicable on first working day of the month, one month prior to the date of delivery.

Cu_o Price of CC copper rods. This price is as applicable on first working day of the month, one month prior to the date of tendering.

STEEL

FeF Variation factor for steel

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.

Fe_o 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.

The above prices and indices are as published by IEEMA vide Circular reference IEEMA(PVC)/CABLE/--/-- 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, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

New Delhi
Rishyamook Building, First Floor
85 A, Panchkuian Road
New Delhi 110001, India
P: +91 11 2336 3013/14
F: +91 11 2336 3015
E: delhi@ieema.org

Bangalore
204, Swiss Complex
33, Race Course Road
Bangalore 560001, India
P: +91 80 2220 1316/18
F: +91 80 2220 1317
E: bangalore@ieema.org

Kolkata
503 A, Oswal Chambers
2, Church Lane
Kolkata 700001, India
P: +91 33 6510 7855
P: +91 33 2213 1326
E: kolkata@ieema.org

6

ieema
your link to electricity

IEEMA (PVC)/Instrumentation Cable/2014 **Effective from: 1st July 2014**

Notes

(a) All prices of raw materials are exclusive of modvatable excise/CV duty amount and exclusive of any other central, state or local taxes, octroi, etc.

(b) All Prices are as on first working day of the month.

(c) The details of prices are as under:

1. Price of CC copper rods (in Rs/MT) is ex-works price as quoted by the primary producer.

2. 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 formula for 'Instrumentaion Cables'

P = Po + CuF (Cu – Cuo) + FeF (Fe – Feo)

1. **For Pair Instrumentation Over all Screen Cables**

Tables References:

Cu POS Copper Factor
Fe POS Steel Factor

2. **For Pair Instrumentation Individual and Over all Screen Cables**

Tables References:

Cu PIS Copper Factor
Fe PIS Steel Factor

3. **For Triad Instrumentation Over all Screen Cables**

Tables References:

Cu TOS Copper Factor
Fe TOS Steel Factor

4. **For Triad Instrumentation Individual & Overall Screen Cables**

Tables References:

Cu TIS Copper Factor
Fe TIS Steel Factor

Deputy Director General

534351/2021/PS-PEM-EL

CIN No. U99999MH1970GAP014629

ieema®
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers, 132, Dr. A. B. Road, Worli, Mumbai - 400 018. INDIA.
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

Cir. No. 35/DIV/ CAB/05/ 24th April 2018

To Members of the Cable Division, Utilities, Railways & Listed purchasing organizations

Sub: Correction in PV formulae of LT XLPE Power Cable and addition of factors for HT XLPE Power Cables

We have recently published revised Price Variation Clause for LT&HT XLPE Power Cables and made it effective from 1st November 2017 vide Cir. No.111/DIV/CAB/05 dated 5th December 2017

While replying to a query of a buyer it is observed that the polymer factor for LT XLPE Power Cables (both aluminium and copper) was incorrectly represented by Table P2.

We have now corrected the anomaly by correcting the PV formulae of LT XLPE Aluminium and Copper Insulated Cables (Sl. No. D & E) by representing Polymer factor by Table L2.

We have also worked out factors for XLPE, Copper and Steel for 3 core HT XLPE Power Cables for 500 and 630 sq.mm.

We now enclose complete PV clause of Cable by including all the PV formulae of different types of power cable (Sl. No. A to I), polymer factor Table L2 and updated XL4, H2 and H5 Table of factors for your perusal & record.

We request to replace PV clause of Cable already circulated vide Cir. 111/DIV/CAB/05 dated 5th December 2017 with the enclosed PV clause in your records for future use.

Senior Director

Encl: as above

11

CIN No. U99999MH1970GAP014629

ieema®
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers, 132, Dr. A. B. Road, Worli, Mumbai - 400 018. INDIA.
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA (PVC)/CABLE(R-1)/2017 Effective from: 1st November 217

Material Price Variation Clause For PVC And XLPE Insulated 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 Price quoted/confirmed (in Rs/Km)

ALUMINIUM

AlF Variation factor for aluminium

Al Price of Aluminiujm. This price is as applicable of first working day of the month, one month prior to the date of delivery.

Alo Price of aluminium. This price is as applicable on first working day of the month, 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 on first working day of the month, one month prior to the date of delivery.

Cuo Price of CC copper rods. This price is as applicable on first working day of the month, 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.

CIN No. U99999MH1970GAP014629

ieema®
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumbai –400 018.
INDIA.
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA (PVC)/CABLE(R-1)/2017 Effective from: 1st November 217

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.

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.

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, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

Notes

(a) All prices of raw materials are exclusive of GST amount.
(b) All prices excluding Aluminium & Copper are as on first working day of the month.
(c) 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).

CIN No. U99999MH1970GAPO14629

ieema®
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumbai - 400 018.
INDIA.
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
w www.ieema.org

IEEMA (PVC)/CABLE(R-1)/2017 Effective from: 1st November 217

Price variation formulae for 'Power Cables'

A. Aluminum conductor PVC insulated 1.1 kV power cables

P = Po + AlF (AL – Alo) + CCFAl (PVCc – PVCco) + FeF (Fe - Feo)

For unarmourd multicore cables (without steel armour); FeF = 0

Table References:

ALP	Aluminium conductor in single core unarmoured & multicore cables
P1	Aluminium conductor aluminium armour in single core armoured cables
P2	PVC compound
P3	Steel armour

B. Copper conductor PVC insulated 1.1 kV power cables

P = Po + CuF (Cu – Cuo) + CCFCu (PVCc – PVCco) + Fef (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0
For unarmoured cables; FeF, AlF = 0

Tables References:

CUP	Copper conductor
P2	PVC compound
P3	Steel armour
P4	Aluminium armour

C. Copper conductor PVC insulated 1.1 kV control cables

P = Po + CuF (Cu – Cuo) + CCFCu (PVCc-PVCco) + FeF (Fe-Feo)

For unarmoured cables; FeF = 0

Tables References:

CUC	Copper conductor
P5	PVC compound
P6	Steel armour

D. Aluminum conductor XLPE insulated 1.1 kV power cables

P = Po + AlF (AL – Alo) +XLFAL(CC-Cco)+ CCFAl (PVCc – PVCco) + FeF (Fe - Feo)

For unarmourd multicore cables (without steel armour); FeF = 0

Table References:

ALP	Aluminium conductor in single core unarmoured & multicore cables
P1	Aluminium conductor aluminium armour in single core armoured cables
L2	Polymer (CCFAl)
P3	Steel armour
XL1	XLPE Compound (XLFAL)

E. Copper conductor XLPE insulated 1.1 kV power cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc – PVCco) + Fef (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkulan Road, New Delhi – 110001, INDIA.
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

CIN No. U99999MH1970GAP014629

ieema®
your link to electricity

Indian Electrical & Electronics Manufacturer's Association
501, Kakad Chambers
132, Dr. A. B. Road, Worli,
Mumbai - 400 018.
INDIA.
P +91 22 2493 0532
F +91 22 2493 2705
E mumbai@ieema.org
W www.ieema.org

IEEMA (PVC)/CABLE(R-1)/2017 Effective from: 1st November 217

For unarmoured cables; FeF, AlF = 0

Tables References:

CUP	Copper conductor
L2	Polymer (CCFCu)
P3	Steel armour
P4	Aluminium armour
XL1	XLPE Compound (XLFCu)

F. Copper conductor XLPE insulated 1.1 kV control cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc-PVCco) + FeF (Fe-Feo)

For unarmoured cables; FeF = 0

Tables References:

CUC	Copper conductor
P5	PVC compound
P6	Steel armour
XL2	XLPE Compound

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

P = Po + AlF (Al – Alo) + XLFAL(CC-Cco)+CCFAl (PVCc – PVCco) + FeF (Fe – Feo)

For unarmoured multicore cables (without steel armour); FeF = 0

Table Refernces:

ALP	Aluminium conductor in single core unarmoured & multicore cables
H1	Aluminium conductor + aluminium armour in single core armoured cables
H2	Polymer
H3/H5	Steel armour (Flat/Round)
XL3/XL4	XLPE Compound (Single core /Multicore)

H. Copper conductor XLPE insulated 3.3 to 33 kV power cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc – PVCco) + FeF (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0

For unarmoured cables; FeF, AlF = 0

Table References:

CUP	Copper conductor
H2	Polymer
H3/H5	Steel armour (Flat/Round)
H4	Aluminium armour
XL3/XL4	XLPE Compound (Single core /Multicore)

I. Copper conductor XLPE insulated 1.0 and 1.5 kV Solar PV DC cables

P = Po + CuF (Cu – Cuo)

Table CUsdc Copper Conductor

Authorized Signatory

HEAD OFFICE - DELHI
Rishyamook Building, First Floor, 85 A, Panchkuian Road, New Delhi – 110001, INDIA.
P +91 11 2336 3013 / 14 • F +91 11 2336 3015 • E delhi@ieema.org • W www.ieema.org

ieema®
your link to electricity

IEEMA (PVC)/CABLE(R-1)/2017 Effective from: 1st November 217

TABLE CUC

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

No of Cores	Core size 1.5 sq mm	Core size 2.5 sq mm
2	0.026	0.047
3	0.039	0.070
4	0.052	0.094
5	0.065	0.117
6	0.078	0.141
7	0.091	0.164
8	0.110	0.182
9	0.117	0.205
10	0.130	0.235
12	0.157	0.282
14	0.183	0.329
16	0.209	0.376
18	0.246	0.410
19	0.248	0.446
20	0.260	0.456
24	0.313	0.563
27	0.352	0.634
30	0.391	0.704
37	0.483	0.869
44	0.573	1.033
52	0.678	1.221
61	0.796	1.432

Factors for 5C x 4 sq.mm to be considered as:

	CuF	CCFCu	FeF
5C X 4 sq.mm	0.188	0.216	0.392

ieema®
your link to electricity

IEEMA (PVC)/CABLE(R-1)/2017 Effective from: 1st November 217

TABLE P5

VARIATION FACTOR FOR PVC COMPOUND (CCFCu)
PVC INSULAYTED CONTROL CABLES WITH COPPER CONDUCTOR

No of cores	Core size 1.5 sq mm		Core size 2.5 sq mm	
	Unarm	Arm	Unarm	Arm
2	0.118	0.121	0.125	0.139
3	0.121	0.131	0.141	0.157
4	0.137	0.152	0.161	0.179
5	0.157	0.174	0.187	0.206
6	0.179	0.199	0.234	0.260
7	0.179	0.199	0.234	0.260
8	0.193	0.215	0.292	0.325
9	0.216	0.241	0.300	0.335
10	0.236	0.262	0.303	0.337
12	0.249	0.277	0.334	0.371
14	0.311	0.327	0.389	0.409
16	0.344	0.362	0.435	0.458
18	0.352	0.371	0.474	0.500
19	0.375	0.395	0.476	0.501
20	0.391	0.412	0.519	0.546
24	0.457	0.481	0.584	0.615
27	0.491	0.517	0.631	0.664
30	0.529	0.557	0.706	0.743
37	0.615	0.647	0.835	0.879
44	0.739	0.778	1.019	1.026
52	0.845	0.889	1.100	1.158
61	0.952	1.002	1.246	1.312

ieema®
your link to electricity

IEEMA (PVC)/CABLE(R-1)/2017 Effective from: 1st November 217
TABLE P6 (Additional)

VARIATION FACTOR FOR ROUND WIRE 'W' STEEL (FeF)
PVC INSULATED CONTROL CABLES WITH COPPER CONDUCTOR

No. of Cores	Core size 1.5 sq mm	Core size 2.5 sq mm
2	0.243	0.273
3	0.257	0.289
4	0.277	0.314
5	0.303	0.342
6	0.329	0.379
7	0.329	0.379
8	0.341	0.456
9	0.383	0.508
10	0.408	0.535
12	0.510	0.572
14	0.546	0.625
16	0.581	0.660
19	0.608	0.696
24	0.714	0.819
25	0.679	0.798
27	0.732	0.837
28	0.696	0.815
30	0.758	0.881
33	0.747	0.883
37	0.820	1.217
44	0.926	1.355
48	1.122	1.308
50	1.122	1.308
52	1.149	1.361
56	1.202	1.388
61	1.299	1.520