VOLUME-II

TECHNICAL SPECIFICATION

FOR

LT PVC CONTROL CABLE

SPECIFICATION NO: ***PE-RC-999-507-E004***

REVISION: **00**

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

CONTENTS

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

COMPLIANCE CERTIFICATE

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

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

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

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

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

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in "BOQ-Cum-Price schedule" of the specification shall not be considered (i.e., technical description & quantities as per specification shall prevail).

BIDDER'S STAMP & SIGNATURE

1.0 PURPOSE

This specification is intended for finalization of rate contract between BHEL PEM and Bidder. Standard technical detail as indicated in the specification shall be agreed upon between BHEL PEM and bidder. Project specific technical detail shall be made available to the bidder along with project enquiry.

2.0 SCOPE OF ENQUIRY

2.1 Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of LT PVC Control Cable conforming to this specification.

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

2.3 Technical requirements of LT PVC Control Cable are indicated in Data Sheet-A & Section-II.

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

3.0 BILL OF QUANTITIES

The bidder to quote for items as per price schedule attached with NIT. **The quantity as mentioned in the BOQ is only for evaluation purpose.** However actual ordered quantity may vary from project to project throughout the contract.

4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

4.1 After rate contract; against specific project requirement following information shall be furnished by BHEL: -

a) BOQ (Bill of Quantities)

4.2 Following documents shall be submitted for specific project requirement after placement of order for BHEL & customer's approval: -

Sl. No.	Drawing / Document Description	Drawing / Document no	Document Type	First Submission	Resubmission
1	Technical Data sheet - LT PVC Control cables	PE-V0-XXX-507-E131	Primary	Within 2 week of award of contract.	Within 1 week of comments
2	Cross-sectional Drgs.- LT PVC Control Cables	PE-V0-XXX-507-E133	Primary	Within 2 week of award of contract.	Within 1 week of comments
3	Quality Plan - LT PVC Control Cables	PE-V0-XXX-507-E915	Primary	Within 2 week of award of contract.	Within 1 week of comments

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

DATA SHEET-A (ARMOURED 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 PVC Type-A
(b)	Standard Applicable	IS: 5831
(c)	Continuous withstand temperature	70°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 PVC Type ST-1
(b)	Standard Applicable	IS: 5831
(c)	Colour	*Black*
(d)	Whether FR-LSH Applicable	*No (Project specific requirement shall be informed later)*
(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 (Material of filler to be compatible with that of inner sheath)
(h)	Method of application for multi-core cables:	
(i)	With fillers	*Pressure/Vacuum extruded*
(ii)	Without fillers	*Pressure extruded*

9.0	*ARMOUR*	
(a)	*Applicable*	*YES*
(b)	Material:	*Galvanised Steel Round Wire, as per BOQ-Cum price schedule.* *Galvanised Steel Formed Wire/Strip, as per BOQ-Cum price schedule.* conforming to (i) Type 'a'/ 'b' as per Table-5 of IS 1554-I and (ii) IS 3975 as per project requirements.
(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 PVC Type ST1
(b)	Standard Applicable	IS: 1554 (Part-1) & IS: 5831
(c)	Colour	*Black / Grey (as per project specific requirement)*
(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	*Cable size (cross section area and no. of cores), voltage grade, PVC, Ref. IS, FRLS, Manufacturer's name and/ or trade name, and year of manufacture @ 5m (by embossing)* *'BHEL-PEM' and 'CUSTOMER' Name @5m (by embossing)* *Progressive sequential marking @ 1m. (by printing/ embossing)* *Further customer specific marking requirement (if any) shall be informed later.*
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	
(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*	*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
(d)	Construction Details	*Clause no 4.2 of Section-II of this technical specification*
(e)	Particular details on Drum	*Clause no 4.3 of Section-II of this technical specification. Further customer specific marking requirement (if any) shall be informed later.*

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	**PVC 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)	

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	

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 PVC 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 PVC 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.

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.

	QUALITY PLAN	CUSTOMER :	PROJECT :	SPECIFICATION :
			TITLE	NUMBER :
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PE-QP-999-507-E003, R-1	SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR LT PVC CONTROL CABLE
	SHEET 1 of 8	SYSTEM	ITEM :LT PVC CONTROL CABLE	SECTION: VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
Instructions:												
1. Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch/ lot no. should be traceable to the final cable drum number or batch no.												
2. Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not.												
1.0	**RAW MATERIAL**											
1.1	Copper Rods	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample per Batch	IS 1554 Pt-1/ IS 613/ IS 5082 & Approved datasheet	IS 1554 Pt-1/ IS 613/ IS 5082 & Approved datasheet	Inspection Report/ Test Cert.	3/2	-	1/2	
		2. Elec.Properties	MA	Electrical Tests	Sample per Batch	IS 1554 Pt-1/ IS 613/ IS 5082 & Approved datasheet	IS 1554 Pt-1/ IS 613/ IS 5082 & Approved datasheet	Inspection Report/ Test Cert.	3/2	-	1/2	
		SPECIFIC CHECKS :										
		a) Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC / Test Cert.	3/2	-	1	
		b) Grade	MA	-do-	-do-	Approved datasheet	Approved datasheet	Inspection Report/ Test Cert.	3/2	-	1	
		c) Resistivity	MA	Electrical Tests	Manufacturer std.	IS 613/ IS 5082	IS 613/ IS 5082	Inspection Report/ Test Cert.	3/2	-	1	
1.2	PVC Compound (for insulation)	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample per batch	IS 1554 Pt-1/ IS 5831 & Approved datasheet	IS 1554 Pt-1/ IS 5831 & Approved datasheet	Inspection Report/ Test Cert.	3/2	-	1/2	
		2. Elec.Properties	MA	Electrical Tests	Sample per batch	IS 1554 Pt-1/ IS 5831 & Approved datasheet	IS 1554 Pt-1/ IS 5831 & Approved datasheet	Inspection Report/ Test Cert.	3/2	-	1/2	
		SPECIFIC CHECKS :										
		a) Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC / Test Cert.	3/2	-	1	
		b) Type/ Grade	MA	Verify	100%	Approved datasheet	Approved datasheet	-do-	3/2	-	1	
		c) Shelf life/ Storage condition	MA	Verify	100%	Compound Manufacturer std.	Compound Manufacturer std.	-do-	3/2	-	1	
1.3	Fillers (as applicable)	1. Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC / Test Cert.	3/2	-	1	
		2. Flame retardant & moisture resistant. (as applicable)	CR	Chemical/ Environ.	100%	Approved datasheet	Approved datasheet	COC / Test Cert.	3/2	-	2	(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)

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

	QUALITY PLAN	CUSTOMER :	PROJECT : TITLE	SPECIFICATION : NUMBER :
	SHEET 2 of 8	BIDDER/ VENDOR :	QUALITY PLAN NUMBER PE-QP-999-507-E003, R-1	SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR LT PVC CONTROL CABLE
		SYSTEM	ITEM :LT PVC CONTROL CABLE	SECTION: VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.4	Galvanised steel wire/strip for Armour (if applicable)	**GENERAL :**										
		1. Make	MA	Verify	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Inspection Report/ Test Cert.	3/2	-	1	
		2. Dimension	MA	Measurement	Manufacturer std.	IS 1554 Pt-1/ IS 3975 & Approved datasheet	IS 1554 Pt-1/ IS 3975 & Approved datasheet	Inspection Report/ Test Cert.	3/2	-	2	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	IS 1554 Pt-1/ IS 3975	IS 1554 Pt-1/ IS 3975	Inspection Report/ Test Cert.	3/2	-	2	* Sample from each armoured size/ Batch/ Lot
		4.Galvanization Quality	MA	Galv.Tests	Sample*	IS 1554 Pt-1/ IS 3975	IS 1554 Pt-1/ IS 3975	Inspection Report/ Test Cert.	3/2	-	2	
1.5	PVC compound for Sheath	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample per batch	IS 1554 Pt-1/ IS 5831 & Approved datasheet	IS 1554 Pt-1/ IS 5831 & Approved datasheet	Inspection Report/ Test Cert.	3/2	-	1/2	
		2. Elec.Properties	MA	Electrical Tests	Sample per batch	IS 1554 Pt-1/ IS 5831	IS 1554 Pt-1/ IS 5831	Inspection Report/ Test Cert.	3/2	-	1/2	
		3. FRLS Properties (as applicable)	CR	Chemical/ Environ.	Sample per batch	IS 1554 Pt-1/ IS 5831 & Approved datasheet	IS 1554 Pt-1/ IS 5831 & Approved datasheet	Inspection Report/ Test Cert.	3/2	-	1/2	
		SPECIFIC CHECKS :										
		a) Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	3/2	-	1	
		b) Type/ Grade	MA	Verify	100%	Approved datasheet	Approved datasheet	COC/ Test Cert.	3/2	-	1	
		c) Shelf life/ Storage condition	MA	Verify	100%	Compound Manufacturer std.	Compound Manufacturer std.	COC/ Test Cert.	3/2	-	1	
1.6	Wooden drums	1. Phy. & Constructional checks	MA	Visual	Mfr's Plant Std.	IS 10418	IS 10418	Inspection Report/ Test Cert.	3/2	-	1	
		2. Anti termite treatment	MA	Chem.	Mfr's Plant Std.	Mfr's Plant Std.	Mfr's Plant Std.	COC	3/2		1	
1.7	Steel drums #	1. Dimension	MA	Meas.	Mfr's Plant Std.	Approved drawing of steel drum / BHEL specification	Approved drawing of steel drum / BHEL specification	Inspection Report/ Test Cert.	3/2	-	1	# (If applicable)
		2. Surface finish	MA	Visual	Mfr's Plant Std.	Surface shall be smooth	Surface shall be smooth	Inspection Report.	3/2		1	
2.0	**IN PROCESS**											
2.1	Wire Drawing & Annealing.	1. Size	MA	Dimensional	Plant Mfg. Std.	IS 1554 Pt-1./ IS 8130 & Approved Data Sheet	IS 1554 Pt-1./ IS 8130 & Approved Data Sheet	Inspection Report	2	-	1	
		2. Surface finish	MA	Visual	Plant Mfg. Std.	Surface shall be smooth	Surface shall be smooth	Inspection Report	2	-	1	
		3. % of Elongation	MA	Mechanical	Plant Mfg. Std.	IS 1554 Pt-1./ IS 8130 & Approved Data Sheet	IS 1554 Pt-1./ IS 8130 & Approved datasheet	Inspection Report	2	-	1	
2.2	Tinning (For Conductor)	1. Size	MA	Dimensional	Plant Mfg. Std.	Approved datasheet	Approved datasheet	Inspection Report	2	-	1	(Applicable only for tin-coated copper conductor)
		2. Chemical test for Tinning (if applicable)	CR	Chemical Test	Sample	IS 1554 Pt-1/ IS:8130 & Mfrs Std	IS 1554 Pt-1/ IS:8130 & Mfrs Std	Inspection Report	2	-	-	

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

	QUALITY PLAN	CUSTOMER :	PROJECT : TITLE					SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :	QUALITY PLAN NUMBER PE-QP-999-507-E003, R-1					SPECIFICATION TITLE	TECHNICAL SPECIFICATION FOR LT PVC CONTROL CABLE		
	SHEET 3 of 8	SYSTEM	ITEM :LT PVC CONTROL CABLE					SECTION	VOLUME III		

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.3	Stranding of wires	1. No.of wires	MA	Counting	Plant Mfg. Std.	IS 1554 Pt-1./ IS 8130 & Approved Data Sheet	IS 1554 Pt-1./ IS 8130 & Approved Data Sheet	Inspection Report	2	-	-	
		2. Resistance	CR	Electrical	Plant Mfg. Std.	IS 1554 Pt-1./ IS 8130 & Approved Data Sheet	IS 1554 Pt-1./ IS 8130 & Approved Data Sheet	Inspection Report	2	-	-	
		3. Sequence, lay length & Direction	MA	Visual, Measurement	One Sample of each size/ lot	Mfrs Std. / Appd. Datasheet	Mfrs Std. / Appd. Datasheet	Inspection Report	2	-	-	
		4. Surface Finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inspection Report	2	-	-	
		5.Dimension	MA	Measurement	One Sample of each size/ lot	IS 1554 Pt-1/ IS 8130/Appd. Data Sheet	IS 1554 Pt-1/ IS 8130/Appd. Data Sheet	Inspection Report	2	-	-	
2.4	Core Insulation (No repair permitted)	1. Surface finish	MA	Visual	100%	Free from bulging burnt particles lumps, cuts & Scratches.	Free from bulging burnt particles lumps, cuts & Scratches.	Inspection Report	2	-	1	
		2 Insulation thickness	CR	Measurement	One Sample of each size/ lot	IS 1554 Pt-1 & Appd.data sheet	IS 1554 Pt-1 & Appd.data sheet	Inspection Report	2	-	-	
		3. Concentricity #	CR	Measurement	One Sample of each size/ lot	Mfrs Std/ IS 1554 Pt-1/ Approved Data Sheet	Mfrs Std/ IS 1554 Pt-1/ Approved Data Sheet	Inspection Report	2	-	1	# To be checked at starting & finish end of Extruded Length
		4 Dia over insulation	MA	Measurement	One Sample of each size/ lot	IS 1554 Pt-1 & Approved Data Sheet	IS 1554 Pt-1 & Approved Data Sheet	Inspection Report	2	-	-	
		5. Core identification	MA	Visual	100%	IS 1554 Pt-1 & Appd. Data Sheet	IS 1554 Pt-1 & Appd. Data Sheet	Inspection Report	2	-	-	
		6. Tensile Strength & % Elongation	MA	Mechanical	100%	IS 1554 Pt-1/ IS 5831 & Approved Data Sheet	IS 1554 Pt-1/ IS 5831 & Approved Data Sheet	Inspection Report	2	-	-	
		7 Spark Test or Water Immersion test	CR	Electrical	100%	Mfr's Std.	Mfr's Std.	Inspection Report	2	-	1	
2.5	Core Laying	1. Dia over laidup core	MA	Measurement	One Sample of each size/ lot	IS 1554 Pt-1 & Approved Data Sheet	IS 1554 Pt-1 & Approved Data Sheet	Inspection Report	2	-	-	
		2. Sequence of lay, Lay length & direction for laid up core	MA	Visual & Meas.	One Sample of each size/ lot	IS 1554 Pt-1 & Mfrs Std.	IS 1554 Pt-1 & Mfrs Std.	Inspection Report	2	-	-	
		3. Core Identification	MA	Visual	One Sample of each size/ lot	IS 1554 Pt-1 & Appd. Data Sheet	IS 1554 Pt-1 & Appd. Data Sheet	Inspection Report	2	-	-	

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

	QUALITY PLAN	CUSTOMER :			PROJECT : TITLE			SPECIFICATION : NUMBER :			
		BIDDER/ VENDOR :			QUALITY PLAN NUMBER PE-QP-999-507-E003, R-1			SPECIFICATION TITLE			TECHNICAL SPECIFICATION FOR LT PVC CONTROL CABLE
	SHEET 4 of 8	SYSTEM			ITEM :LT PVC CONTROL CABLE			SECTION			VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.6	InnerSheath Extrusion (If applicable)	1. Surface finish	MA	Visual	100%	Surface shall be Smooth	Surface shall be Smooth	Inspection	2	-	-	(Pimple, fish eye, porosity & burnt particles not permitted)
		2. Sheath thickness	CR	Measurement	One Sample of each size/ lot	IS 1554 Pt-1 & Approved Data Sheet	IS 1554 Pt-1 & Approved Data Sheet	Inspection Report	2	-	-	
		3.Dia over inner sheath	MA	Measurement	One Sample of each size/ lot	IS 1554 Pt-1 & Approved Data Sheet	IS 1554 Pt-1 & Approved Data Sheet	Inspection Report	2	-	-	
2.7	Armouring (If applicable)	1. No.of wires/Strips	MA	Counting	At the start of the process	IS 1554 Pt-1/ IS 3975 & Approved Data Sheet	IS 1554 Pt-1/ IS 3975 & Approved Data Sheet	Inspection Report	2	-	-	
		2. Lay Direction	MA	Visual	At the start of the process	IS 1554 Pt-1/ IS 3975	IS 1554 Pt-1/ IS 3975	Inspection Report	2	-	-	
		3. Lay Length	MA	Visual, Meas.	At the start of the process	IS 1554 Pt-1/ IS 3975	IS 1554 Pt-1/ IS 3975	Inspection Report	2	-	-	
		4. Coverage	MA	Measurement	At the start of the process	IS 1554 Pt-1/ IS 3975 & approved data sheet	IS 1554 Pt-1/ IS 3975 & approved data sheet	Inspection Report	2	-	-	
		5. Dia over armouring	MA	Measurement	At the start of the process	IS 1554 Pt-1 & Appd. Data Sheet	IS 1554 Pt-1 & Appd. Data Sheet	Inspection Report	2	-	-	
2.7	Outer Sheath Extrusion	1. Surface Finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inspection Report	2	-	-	(Pimple, fish eye, porosity & burnt particles not permitted)
		2.Sheath thickness	CR	Measurement	One Sample of each size/ lot	IS 1554 Pt-1 & Appd. Data Sheet	IS 1554 Pt-1 & Appd. Data Sheet	Inspection Report	2	-	-	
		3. Dia over outer sheath	MA	Measurement	One Sample of each size/ lot	IS 1554 Pt-1 & Appd. Data Sheet	IS 1554 Pt-1 & Appd. Data Sheet	Inspection Report	2	-	-	
		4. Marking/ Color/ Embossing	MA	Visual	One Sample of each size/ lot	Appd. Data Sheet	Appd. Data Sheet	Inspection Report	2	-	-	
2.8	Finished Cable (INTERNAL)	1. Routine Test (Refer Note-H)	CR	Electrical Tests & Measurement	100%	IS 1554-I & Appd. Datasheet	IS 1554-I & Appd. Datasheet	Test Report	2	-	1	

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

	QUALITY PLAN		CUSTOMER :			PROJECT : TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER PE-QP-999-507-E003, R-1			SPECIFICATION TITLE			TECHNICAL SPECIFICATION FOR LT PVC CONTROL CABLE
		SHEET 5 of 8	SYSTEM			ITEM :LT PVC CONTROL CABLE			SECTION			VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**			**11**
3.0	Final Inspection	1. Finish	MA	Visual	(See remark)	IS 1554 Pt-1/ Appd. Data Sheet	Free from Porosity, Bulging,Burnt particles, lumps, cuts & scratches	Test Report	2	1	-	One drum each for Power & Control cables in Lot.
		2. Length	MA	Measurement	(See remark)	IS 1554 Pt-1/ Appd. Data Sheet	BHEL Spec./ Data Sheet	Test Report	2	1		Length of each drum shall be as per tolerance given in the data sheet.
		3. Dimension	MA	Measurement	As per IS	IS 1554 Pt-1/ Appd. Data Sheet	Approved Data Sheet	Test Report	2	1	-	
		4. Armouring - Coverage No.of Wires/Strips	MA	Visual & Meas.	As per IS	IS 1554 Pt-1/ Appd. Data Sheet	Appd.Data Sheet	Test Report	2	1	-	
		4. Marking/Colour Coding	MA	Visual	As per IS	IS 1554 Pt-1/ Appd. Data Sheet	IS 1554 Pt-1/ Appd. Data Sheet	Test Report	2	1	-	
		5. Acceptance Tests (Refer Note-H)	CR	Phy & Elect. Tests FRLS tests	As per IS	IS 1554 Pt-1/ Appd. Data Sheet	IS 1554 Pt-1/ Appd. Data Sheet	Test Report	2	1		
		6. Type & FRLS Tests (Refer Note-H)	CR	Phy & Elect. Tests FRLS Tests	Sample#	BHEL Specn. Apprd.Data Sheet	BHEL Specn. Apprd.Data Sheet	Test Report	2	1	-	**# Refer Annexure to QAP for Type & Acceptance Tests**
4.0	Packing	Sealing Identification	MA	Visual	100%	As per IS	As per IS	Test Report	2	1	-	

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.

LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL 2-VENDOR 3- SUB VENDOR CHP: CUSTOMER HOLD POINT WHICH WILL BE DECIDED AT CONTRACT STAGE.

	PARTICULARS	**BIDDER/VENDOR**	
BHEL	**NAME**		
	SIGNATURE		
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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	
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	

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
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	
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

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
II.	Flammability test for single cable	For complete cable	T,A	IS: 10810 Pt 61 / IEC:60332 Part-1	as indicated in Datasheet-A
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.