TECHNICAL SPECIFICATION FOR LOW TENSION POWER XLPE CABLES

1.0 INTENT OF SPECIFICATION:

1.1 This specification governs the requirements of design, manufacture, testing packing at manufacturer's work and delivery at site and complete in all respects of this specification.

2.0 APPLICABLE STANDARDS:

The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest versions of below standards.

IS 7098-1	:	Specification for XLPE insulated (Heavy duty) Electric Cables.
IS 209	:	Specification for Zinc
IS-8130	:	Conductors for insulated electric cables and flexible cords.
IS 3975	:	Standard for Mild steel wires, strips & tapes for Armoring.
IS 10810(Pt-41):		Method of test for cables: Mass of zinc coating on steel armour.
IS 10462(Pt-1)	:	Fictitious calculation method for determination of Dimensions of protective coverings of cables: Part-1 Electrometric and thermoplastic insulated cables.
IS 10418	:	Drums for electric cables.
IS 10810(Pt-58):		Oxygen Index test.
IS 10810(Pt-61):		Flame Retardant test.
IS 10810(Pt-62):		Fire resistance test for bunched cables.
IEC 60332-3	:	Tests on electric cables under fire conditions.
ASTM-D2863	:	Standard for critical oxygen index and temperature index test.
ASTM-D2843	:	Standard for smoke generation test.
IEC-754-1	:	Standard for Acid gas generation test.
IEC-332-1	:	Standard for Flammability test.
SS 424 1475 Class F3	:	Standard for Flammability test.
IEEE 383	:	Standard for type test of class IE electric cables, field splices, and connections for Nuclear power generating stations.
IS 5831	:	Standard for PVC Insulation & Sheath of electric cables.
IS 3961(Pt-2)	:	Recommended current ratings for Cables
NEMA – WC 70:		Standard for Non-shielded power cables rated 2000Volts or less for the distribution of electrical energy.
NEMA – WC 53:		Standard test methods for extruded dielectric power, control, instrumentation and portable cables for test.
DIN 53387:		Artificial weathering and ageing of plastics and elastomers by exposure to Filtered Xenon arc radiation
ASTM-G-154:		Standard practice for operating fluorescent light apparatus for UV exposure of non-metallic materials.
BS: 7846:		Electric cables -600/1000V armoured fire resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire.

The cables shall also conform to the provisions of Indian electricity rules and other statutory regulations as applicable.

3.0 CABLE REQUIREMENTS:

a) Voltage grade : 650/1100 V

b) The conductors (heavy duty type, Aluminum (Al.)) shall be solid for conductor of nominal area up to and including 6 sqmm and stranded beyond 6 sqmm. Conductors of nominal area less than 16sq.mm shall be circular only. Conductor of nominal area 16 sqmm and above may be circular or shaped as per IS 8130. Cables with reduced neutral conductor shall have sizes as per table 1 of IS 7098(part-I).

c) Insulation: The core insulation shall be with cross linked polyethylene (XLPE) insulating compound, applied by extrusion. It shall be free from voids and shall withstand all mechanical and thermal stress under steady state and transient operating conditions. It shall conform to the properties given in table-1 of IS: 7098(Pt-1). The Core identification shall be as per IS: 7098-I.

d) Inner sheath : The inner sheath shall be applied over the laid up cores and shall be of PVC compound by extrusion and shall conform to the requirements of type ST 2 compound of IS: 5831. The extruded inner sheath shall be of uniform thickness. Single core cables shall have no innersheath.

e) Armoring: For single core cables , the armouring shall be of non-magnetic material. For multi core cables armoring shall be by galvanised steel wires where the calculated diameter below armouring doesn't exceed 13mm and by galvanized steel strips where this dimension is greater than 13mm. Requirement and methods of tests for armour material and uniformity of galvanization shall be as per IS -3975, IS -10810(Part-41). The dimensions of armour shall be as per method (b) of IS-7098 (Part-1). For single core cables, the armouring shall be with H4 grade hard drawn aluminium round wire of 2.5 mm diameter.

f) Outer sheath : The outer sheath of the cables shall be applied by extrusion over the armouring and shall be of PVC FRLS compound conforming to the requirements of type ST 2 compound of IS: 5831. The minimum and average thickness of outer sheath for unarmoured cables and minimum thickness of outer sheath for armoured cables shall be as per IS: 7098. (Part-1).

g) The thickness of the insulation, inner sheath & outer sheath shall be governed by values given in IS: 7098 (Part-1).

h) Outer sheath of all cables shall be black in color and the minimum value of oxygen index shall be 29 at 27 ± 2° C. In addition suitable chemicals shall be added into the PVC compound of outer sheath to protect the cable against rodent and terminate attack. Outer sheath of unarmored cables shall be green color.

i) All cables covered in this specification shall be flame retardant low smoke (FRLS). The outer sheath of PVC cables shall posses flame propagation properties meeting requirements as per IS-10810 (Part-62) category AF. FRLS cable shall be identified by appropriate legend i.e., "FRLS category-C2" throughout the cable length. FRLS properties shall be as per IS-10810 Part 61 and Part62, IEC 60332 Part1 and Part3, IEEE-383, IEC-61034, IEC-60754 Part1, ASTM-D-2863.

j) On the outer sheath of cable, necessary information such as vendor's name, type, size, voltage grade of the cable, cable code, FRLS category-C2, BHEL Material code shall be embossed. Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing shall be legible and indelible.

k) The overall diameter of the cables shall be strictly as per the values declared by the vendor in the technical information subject to a maximum tolerance of ±2mm up to overall diameter of 60mm and ±3mm for beyond 60mm.

l) The joints in armor wire/strips shall be made by brazing or welding and any surface irregularities shall be removed. A joint in any wire/strip shall be at least 300m from the nearest joint in any wire/strip in the complete cable.

4.0 TESTS:

4.1 The Cables shall be subjected to Type, Routine, Acceptance tests and Special tests as detailed below. BHEL/End User reserves the right to witness all tests with sufficient advance notice from vendor.

4.2 Cables offered shall have valid Type test certificates of recognized testing house such as CPRI, CMRI, PTB, BASEEFA, UL or equivalent.

4.3 The cables shall be tested and inspected at the vendor's works. All the materials employed in manufacture of the cable shall be subjected, both before and after manufacture, to examination, testing and approval by BHEL/End User.

4.4 Vendor shall furnish all necessary information concerning the supply to BHEL.

4.5 The inspector shall have free access to the vendor's works for the purpose of inspecting the process of manufacture in all its stages and will have the power to reject any material, which appears to be of unsuitable description or of unsatisfactory quality.

4.6 The vendor shall give at least 2 weeks advance notice to the purchaser, regarding the date of testing to enable him or his representative to witness the tests.

4.7 Type Tests and Special tests to be conducted/Valid Certificates to be submitted shall be governed by below clauses. If Type tests certificates and Special Tests Certificates (applicable for UV test, Accelerated water absorption test) are not available for any size of cable, same shall be conducted by vendor at his own cost in any recognized laboratory. If in-house test facilities are to be used then the testing equipments shall be calibrated (valid calibration certificates shall be produced during inspection) and traced back to National Calibration standards. The reports shall be submitted for BHEL's approval before dispatch of the cables. There shall not be any delivery and commercial implications on account of this.

4.8 Routine Tests:

All Routine tests on each size of cable as per IS 7098-I & approved data sheet shall be conducted. The Test reports shall be submitted for review to BHEL/BHEL's representative and annexed to the Inspection Report.

4.9 Acceptance Tests:

All Acceptance tests on each size of cable as per IS 7098-I & approved data sheet shall be conducted in the presence of BHEL's representative. The Test reports shall be annexed to the Inspection Report.

4.10 Type Tests:

Type test certificates for the type tests as per IS 7098-I & IS 5831 of not older than 5years (as on date of enquiry) issued by any recognized laboratory for the Size of cable shall be furnished for BHEL's review alongwith Technical data sheets. If Type test certificates are not available refer above clause no. 4.7.

4.11 SPECIAL TESTS:

4.11.1 Ultra Violet radiation Test:

Test for Resistance to Ultra Violet Radiation should be carried as per ASTM-G-53(latest) or ASTM-G-154(latest) on outer sheath. The retention values of tensile strength and ultimate elongation after the test shall be minimum 60% of tensile strength and ultimate elongation before the test. Test certificates to this test (not older than one year) from recognized testing laboratory to be furnished for review by BHEL alongwith Technical Data sheets. In case the Test certificates are not available, refer above clause no. 4.7. Sampling for this test is to be done randomly once for each order, provided outer sheath remains same.

4.11.2 Accelerated water absorption test:

Accelerated water absorption test for insulation as per NEMAWC-53(latest): Test certificates with respect to this test (not older than one year) from recognized testing laboratory to be furnished for review by BHEL alongwith Technical Data sheets. In case test certificates are not available, refer above clause no. 4.7. Sampling for this is to be done randomly once for each order, provided type of insulation remains same.

4.11.3 Oxygen Index Test:

The test shall be carried out as per IS-10810(Part-58). Sampling to be done for every offered lot/size as per sampling plan.

4.11.4 Flammability test:

The test shall be carried out on finished cable as per IS: 10810 (part61& 62). Sampling for these tests to be done randomly once for each order. The acceptance criteria for tests conducted shall be as under:

Part-61-The cable meets the requirement if there is no visible damage on the test specimen within 300mm form its upper end.

Part-62-The maximum extent of the charred portion measured on the test sample should not have reached a height exceeding 2.5m above the bottom edge of the burner at the front of the ladder.

4.11.5 Rodent and Termite repulsion test:

Test for rodent and termite repulsion property shall be carried out. The vendors shall furnish the test details to analyze the property by chemical method for BHEL's review/information. Sampling to be done for every offered lot/size as per sampling plan.

4.12 FRLS Tests:

Following FRLS tests on each size (minimum one sample per size) of cable shall be conducted in the presence of BHEL's representative & reports shall be annexed to Inspection report.

a) Oxygen index test as per ASTM D-2863 and minimum oxygen index shall be 29 at 27+/2degC.
b) Temparature index test as per ASTM D-2863 and minimum temp index shall be 250degC.
c) Acid gas generation test as per IEC-60754(1) amd Maximum acid gas generation shall be 20% by weight.
d) Smoke generation test as per ASTM D-2843 and Maximum smoke density rating shall be 60%.
e) Flammability Test:
   For Cables with OD >35: as per IEEE-383.
   For Cables with OD <=35: as per Clause F3 of SS: 4241475/88.

5.0 PACKING AND DESPATCH:

5.1 Cables shall be dispatched in non-returnable **Steel drums** of suitable barrel diameter, securely battened, with the take-off end fully protected against mechanical damage. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.

5.2 PVC/Rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand meter length. In addition, ends of the cables shall be properly sealed with caps to avoid ingress of water during transportation and storage.

5.3 On the flange of the drum, necessary information such as project title, vendor's name, type, size, voltage grade of the cable, length of the cable in meters, drum no., cable code, BIS certification mark, gross weight etc. shall be printed. An arrow shall be printed on the drum with suitable instructions to show the direction of the rotation of the drum.

5.4 Cables shall be supplied as per following drum lengths:

Multicore Power cables up to 10 mm^2	:	2000 m
Multicore Power cables from 10 mm^2 up to 70 mm^2	:	1000 m
Multicore Power Cables from 95 mm^2 up to 300 mm^2	:	600 m
Single core Power cables up to 630 mm^2	:	1000 m

A tolerance of +3 %(No Negative tolerance) shall be permissible for each drum and overall quantity.

6.0 DOCUMENTATION:

6.1 DRAWINGS, DATA AND MANUAL:

6.1.1 To be submitted along with bid

a. Technical data sheets. Datasheets as per relevant formats given shall be furnished. Separately typed vendor datasheets are NOT acceptable.
b. Type Test Certificates
c. Certificates of Special Tests Type
d. Bidder shall furnish NO Deviations
e. Check list for Bid Submission.

6.1.2 To be submitted in 6 sets after award of contract

Sl.No.	Description
1.	Completely filled in technical data sheets Datasheets as per relevant formats given shall be furnished. Separately typed vendor datasheets are NOT acceptable.
2.	Transport/Shipping dimension drawing
3.	Type Test Certificates
4.	Erection manual
5.	Catalogues

No. of copies to be submitted for each submission shall be as follows

- For Approval & Review documents shall be in 6 copies.

7.0 DEVIATION SCHEDULE

Enquiry No.:

Name of Bidder:

Offer Ref. No.:

DEVIATION FORMAT

Sl. No.	Clause no. & Spec. no.	Description as per Specification	Deviation taken	Nature of Deviation	Remarks

NOTES:

1. Technical offer of the bidder will be evaluated only on the basis of Deviation Schedule. Deviation Schedule constitutes this sheet (with these Notes) duly signed and stamped.
2. Deviations, if any, shall be clearly brought out only in this format. Deviations mentioned / taken elsewhere or in any other format will be ignored.
3. Additional sheets in the same format can be attached by the vendor, if necessary.
4. Nature of Deviations shall only be of Design / Manufacturing constraints and non-availability of items / components / makes in market.
5. No price implications shall be entertained for deviations withdrawn during the technical scrutiny. If any deviations are accepted by BHEL during technical scrutiny then also there will be no price implication. Hence, in no case there will be consideration of Price implications.
6. Reasons for the deviations shall be specified in the Remarks column.
7. If there are no deviations from the specifications, bidder still has to submit the Deviation Schedule by writing "NO Deviations" in this format.
8. If the "Deviation Schedule" is not submitted along with the offer, the bidder's offer is likely to be rejected without any further interaction with the bidder.
9. Only the accepted deviations in conjunction with the original tender shall constitute the contract document for the award of job to the bidder.

SIGNATURE OF BIDDER _____

NAME _____

DESIGNATION _____

COMPANY SEAL

DATE _____

Ref. Doc

8.0 GENERAL:

8.1 CHECKLIST FOR BID SUBMISSION

(TO BE FILLED BY BIDDER AND SUBMITTED ALONG WITH OFFER)

Sl. No.	Description	Bidder Confirmation	Comments/ Remarks
1	Technical offer is conforming to technical specification PY55095 & its associated Annexures (if any), pre-bid clarifications (if any) etc., Bidder to confirm (Yes / No).		
2	Bidder confirms that they have read the provisions of the Deviation Schedule and have included the deviation Schedule in the Offer after agreeing to the said Provisions (Yes/No).		
3	Bidder confirms that Prices for all items have been Quoted. Unpriced & Priced Schedules are included in the Techno-commercial Offer and Priced Offer respectively.(Yes/NO)		
4	As per specification, bidder confirms that complete set of test certificates have been included along with the Offer. In case bidder has not submitted test certificates, bidder confirms to conduct the tests as per cl.no 4.7 and submit the report to BHEL/customer for approval. (YES/NO)		

Notes: Offer received without affirmative confirmation against any of the above points may not be considered for evaluation.

(Signature and stamp of bidder with date)

8.2 Quantities mentioned are tentative requirement. Based on the actual requirement, quantity can be increased or decreased by about 15% on overall qty. Final BOQ will be informed before price bid opening. Unit rates shall be applicable for the revised BOQ also.

8.3 GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN: REFER ANNEXURE-I

8.4 "Vendors should not be part of EIL holiday List. Package vendors will not source the items from sub-vendors who are part of EIL' holiday list"

TABLE-1 - MATERIAL CODIFICATION

Sl.No	Cable size	Armouring	Cond, Insulation & Outer sheath matl.	BHEL Material Code
01	2 C x 4	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095004
02	3 C x 4	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095012
03	3 C x 6	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095020
04	3 C x 10	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095039
05	3 C x 16	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095047
06	3 C x 25	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095055
07	3 C x 35	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095063
08	3 C x 50	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095071
09	3 C x 70	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095080
10	3 C x 95	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095098
11	3 C x 120	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095101
12	3 C x 150	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095110
13	3 C x 185	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095128
14	3 C x 240	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095136
15	3 C x 300	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095144
16	3 C x 400	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095152
17	3.5 C x 35	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095160
18	3.5 C x 50	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095179
19	3.5 C x 70	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095187
20	3.5 C x 95	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095195
21	3.5 C x 120	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095209
22	3.5 C x 150	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095217
23	3.5 C x 185	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095225
24	3.5 C x 240	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095233
25	3.5 C x 300	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095241
26	3.5 C x 400	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095250
27	4 C x 4	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095268
28	4 C x 6	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095276
29	4 C x 10	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095284
30	4 C x 16	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095292
31	1 C x 120	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095306
32	1 C x 240	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095314
33	1 C x 6	Un Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095322
34	1 C x 10	Un Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095330
35	1 C x 25	Un Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095349

36	1 C x 35	Un Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095357
37	1 C x 50	Un Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095365
38	1 C x 70	Un Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095373
39	1 C x 150	Un Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095381
40	1 C x 300	Un Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095390
41	1 CX630	Armoured	Al. Cond. XLPE/FRLS PVC Cable	PY9755095403
42	1 CX1000	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095411
43	3.5 C x 25	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095420
44	4CX25	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095500
45	4CX35	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095519
46	4CX70	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095527
47	4CX185	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095535
48	4CX240	Armoured	Al. Cond. XLPE /FRLS PVC Cable	PY9755095543

Ref. Doc

RECORD OF REVISIONS				
Rev. No.	Date	Revision Details	Revised	Approved
00	28.11.14	Original Issue	-	PCS
01	28.04.18	Generally revised	-	JKP