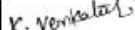


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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company.		<u>TECHNICAL SPECIFICATION FOR HIGH TENSION POWER CABLES</u>																																								
		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. <table border="0"> <tr> <td>IS 7098(Pt-2) :</td> <td>Specification for XLPE insulated (Heavy duty) Electric Cables.</td> </tr> <tr> <td>IS-8130 :</td> <td>Conductors for insulated electric cables and flexible cords.</td> </tr> <tr> <td>IS 3975 :</td> <td>Standard for Mild steel wires, strips & tapes for Armoring.</td> </tr> <tr> <td>IS 5831 :</td> <td>PVC insulation and sheath of electric cables.</td> </tr> <tr> <td>IS 10810(Pt-41):</td> <td>Method of test for cables: Mass of zinc coating on steel armour.</td> </tr> <tr> <td>IS 10462(Pt-1) :</td> <td>Fictitious calculation method for determination of Dimensions of protective coverings of cables: Part-1 Electrometric and thermoplastic insulated cables.</td> </tr> <tr> <td>IS 10418 :</td> <td>Drums for electric cables.</td> </tr> <tr> <td>IS 10810(Pt-58):</td> <td>Oxygen Index test.</td> </tr> <tr> <td>IS 209 :</td> <td>Specification for Zinc</td> </tr> <tr> <td>IS 10810(Pt-61):</td> <td>Flame Retardant test.</td> </tr> <tr> <td>IS 10810(Pt-62):</td> <td>Fire resistance test for bunched cables.</td> </tr> <tr> <td>IEC 60332-3 :</td> <td>Tests on electric cables under fire conditions.</td> </tr> <tr> <td>ASTM-D2863 :</td> <td>Standard for critical oxygen index and temperature index test.</td> </tr> <tr> <td>NEMA – WC 70:</td> <td>Standard for Non-shielded power cables rated 2000Volts or less for the distribution of electrical energy.</td> </tr> <tr> <td>NEMA – WC 53:</td> <td>Standard test methods for extruded dielectric power, control, instrumentation and portable cables for test.</td> </tr> <tr> <td>DIN 53387:</td> <td>Artificial weathering and ageing of plastics and elastomers by exposure to Filtered Xenon arc radiation</td> </tr> <tr> <td>ASTM-G-154:</td> <td>Standard practice for operating fluorescent light apparatus for UV exposure of non-metallic materials.</td> </tr> <tr> <td>BS: 7846:</td> <td>Electric cables -600/1000V armoured fire resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire.</td> </tr> </table> The cables shall also conform to the provisions of Indian electricity rules and other statutory regulations as applicable. 3.0 TECHNICAL REQUIREMENTS: a) Voltage grade : 3.3kV(UE), 6.6kV(UE), 11kV (UE), 22kV(E) & 33kV(E) – Bidder to offer as per Material Code in Table-1. b) Conductor: Stranded and compacted circular Copper. Conductors shall be provided with non-metallic extruded semi conducting screen. c) Insulation: The core insulation shall be with cross linked polyethylene insulating compound dry cured, applied by extrusion. It shall be free from voids and shall withstand all mechanical					IS 7098(Pt-2) :	Specification for XLPE insulated (Heavy duty) Electric Cables.	IS-8130 :	Conductors for insulated electric cables and flexible cords.	IS 3975 :	Standard for Mild steel wires, strips & tapes for Armoring.	IS 5831 :	PVC insulation and sheath of electric cables.	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 209 :	Specification for Zinc	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.	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.
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Ref. Doc	Revisions : Refer record of revisions	Prepared :  T.Subrahmanyam	Checked :  K.Venkatesh	Approved :  B.Naveen kumar	Date : 29.07.15																																					

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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		and thermal stress under steady state and transient operating conditions. It shall conform to the properties given in table-1 of IS: 7098(Pt-2). d) Insulation Screen: The insulation screen shall consist of non-metallic extruded semi conducting compound in combination with a non-magnetic metallic copper screen. The copper screen (screens of all the three cores together in case of 3 core cables) shall be capable of carrying the <u>single line to ground fault current as specified in table-1</u>. For single core cable, copper screen provided shall be capable of carrying the single line to ground fault current value and the duration specified in the table-1 e) The conductor screen, XLPE insulation and insulation screen shall be extruded in single head (one) operation by ‘Triple extrusion’ process to ensure perfect bonding between the layers. The core identification shall be by colored strips or by printed numerals. f) 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. In case of single core cables, inner sheath between insulation metallic screen and armouring is required. g) Armour: For single core cables, the armorng shall be of non-magnetic material. For multicore cables, the armorng shall be by single galvanized steel strips as per <u>method (b)</u> of IS-7098 (Part-2). Requirements and methods of tests for armour material and uniformity of galvanization shall be as per IS: 3975 and IS: 10810 (part-41). For single core cables, the armour shall be with H4 grade hard drawn aluminium round wire of 2.5mm diameter. h) Outer sheath : The outer sheath of the cables shall be applied by extrusion over the armourng and shall be of PVC 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-2). i) The thickness of the insulation, inner sheath, outer sheath shall be governed by values given in IS: 7098 (Part-2). j) Outer sheath of all cables shall be black in color and the minimum value of oxygen index shall be 29 at $27 \pm 2^\circ \text{C}$. In addition suitable chemicals shall be added into the PVC compound of outer sheath to protect the cable against rodent and terminate attack. k) All cables covered in this specification shall be flame retardant and Low Smoke(FRLS). The outer sheath of cables shall posses flame propagation properties meeting requirements as per IS-10810 (Part-62) category AF. FRLS cable shall be identified by indenting, embossing or printing the 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. l) 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. m) 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 $\pm 2\text{mm}$ up to overall diameter of 60mm and $\pm 3\text{mm}$ for beyond 60mm.		
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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.	n) 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-II & 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. QAP: In addition to above clauses, Quality requirements shall also be as per enclosed QAP(Annexure-1) of specification. 4.9 Acceptance Tests: All Acceptance tests on each size of cable as per IS 7098-II & approved data sheet shall be conducted in the presence of BHEL/BHEL's representative. The Test reports shall be annexed to the Inspection Report. QAP: In addition to above clauses, Quality requirements shall also be as per enclosed QAP(Annexure-1) of specification. 4.10 Type Tests: Type test certificates for the type tests as per IS 7098-II & IS 5831 of not older than 5 years (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. QAP: In addition to above clauses, Quality requirements shall also be as per enclosed QAP(Annexure-1) of specification.		
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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		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 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 <u>(not older than one year)</u> from recognized testing laboratory to be furnished <u>for review by BHEL</u> along with 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 <u>(not older than one year)</u> 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 from 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. QAP: In addition to above clauses, Quality requirements shall also be as per enclosed QAP(Annexure-1) of specification. 4.12 FRLS Tests: Following FRLS tests and additional tests for improved fire performance as per IS: 7098-II (if applicable) 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. - Oxygen index test as per ASTM D-2863 and minimum oxygen index shall be 29 at 27+2degC. - Temperature index test as per ASTM D-2863 and minimum temp index shall be 250degC. - Acid gas generation test as per IEC-60754(1) and Maximum acid gas generation shall be 20% by weight. - Smoke generation test as per ASTM D-2843 and Maximum smoke density rating shall be 60%. - Flammability Test: For Cables with OD >35: as per IEC-60332-1-1/2 and IEEE-383. For Cables with OD <=35: as per Clause F3 of SS: 4241475/88.		
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Ref. Doc	5.0 <u>PACKING AND DESPATCH:</u> 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 in drum lengths in general, as follows. However the actual drum length shall be furnished by BHEL during approval of Technical data sheet and shall be binding: HV Power cables –Up to 11kV (E) Grade <table border="0"> <tr> <td>- Three Core cables up to 400mm²</td> <td>:</td> <td>500m</td> </tr> <tr> <td>- Single Core cables up to 400mm²</td> <td>:</td> <td>1000m</td> </tr> </table> HV Power cables –Above 11kV (E) Grade and up to 33kV (E) Grade <table border="0"> <tr> <td>- Three Core cables up to 300mm² grade</td> <td>:</td> <td>500m</td> </tr> <tr> <td>- Single Core cables up to 630mm²</td> <td>:</td> <td>1000m</td> </tr> <tr> <td>- Single Core cables above 630mm² and up to 1000mm²</td> <td>:</td> <td>500m</td> </tr> </table> A tolerance of +3 % (No Negative tolerance) shall be permissible for each drum and overall quantity. 6.0 <u>DOCUMENTATION:</u> 6.1 DRAWINGS, DATA AND MANUAL: 6.1.1 To be submitted along with bid - Technical data sheets. Datasheets as per relevant formats given shall be furnished. Separately typed vendor datasheets are NOT acceptable. - Calculation shall be furnished for the short circuit rating of the copper screen. - Type Test Certificates - Certificates of Special Tests Type - Bidder shall furnish Clausewise compliance alongwith the bid. - Check list for Bid Submission. 6.1.2 To be submitted in 6 sets after award of contract <table border="1"> <thead> <tr> <th>Sl.No.</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Completely filled in technical data sheets Datasheets as per relevant formats given shall be furnished. Separately typed vendor datasheets are NOT acceptable.</td> </tr> <tr> <td>2.</td> <td>Type Test Certificates</td> </tr> <tr> <td>3.</td> <td>Catalogues</td> </tr> <tr> <td>4.</td> <td>Calculation shall be furnished for the short circuit rating of the copper screen.</td> </tr> </tbody> </table> <u>No. of copies to be submitted for each submission shall be as follows</u> ➤ For Approval & Review documents shall be in 6 copies.			- Three Core cables up to 400mm ²	:	500m	- Single Core cables up to 400mm ²	:	1000m	- Three Core cables up to 300mm ² grade	:	500m	- Single Core cables up to 630mm ²	:	1000m	- Single Core cables above 630mm ² and up to 1000mm ²	:	500m	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.	Type Test Certificates	3.	Catalogues	4.	Calculation shall be furnished for the short circuit rating of the copper screen.
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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		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 PY55155 & 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)			
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Copyright and Confidential The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		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.																														
		TABLE -1 : Material Codification <table border="1"> <thead> <tr> <th>Var. No.</th> <th>No. of cores & Sizes (Sq.mm.)</th> <th>Cond,Insulation & Outer sheath matl, Grade</th> <th>Fault current</th> <th>BHEL Material Code</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1CX500</td> <td>Cu, XLPE & PVC /FRLS, 11kV(UE)</td> <td>1kA/1sec.</td> <td>PY9755154000</td> </tr> <tr> <td>2</td> <td>3CX150</td> <td>Cu, XLPE & PVC /FRLS, 11kV(UE)</td> <td>1kA/1sec.</td> <td>PY9755154019</td> </tr> <tr> <td>3</td> <td>3CX300</td> <td>Cu, XLPE & PVC /FRLS, 11kV(UE)</td> <td>1kA/1sec.</td> <td>PY9755154027</td> </tr> <tr> <td>4</td> <td>1CX500</td> <td>Cu, XLPE & PVC /FRLS, 33kV(E)</td> <td>40kA/0.2sec.</td> <td>PY9755154051</td> </tr> <tr> <td>5</td> <td>1CX630</td> <td>Cu, XLPE & PVC /FRLS, 33kV(E)</td> <td>40kA/0.2sec.</td> <td>PY9755154043</td> </tr> </tbody> </table>			Var. No.	No. of cores & Sizes (Sq.mm.)	Cond,Insulation & Outer sheath matl, Grade	Fault current	BHEL Material Code	1	1CX500	Cu, XLPE & PVC /FRLS, 11kV(UE)	1kA/1sec.	PY9755154000	2	3CX150	Cu, XLPE & PVC /FRLS, 11kV(UE)	1kA/1sec.	PY9755154019	3	3CX300	Cu, XLPE & PVC /FRLS, 11kV(UE)	1kA/1sec.	PY9755154027	4	1CX500	Cu, XLPE & PVC /FRLS, 33kV(E)	40kA/0.2sec.	PY9755154051	5	1CX630	Cu, XLPE & PVC /FRLS, 33kV(E)
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8.3 GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN: REFER ANNEXURE-A																																
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”																																
Ref. Doc																																