

**KARNATAKA POWER TRANSMISSION CORPORATION LIMITED**

**SECTION- POWER AND CONTROL CABLE**

## **CONTENTS**

1.0	SCOPE .....	3
2.0	CODES AND STANDARDS .....	3
3.0	SPECIFICATIONS .....	3
4.0	CABLE DRUMS .....	13
5.0	TYPE TESTS .....	15

## **1.0     SCOPE**

- 1.1     This specification covers the requirements of Power Cables upto 33kV, Control, Instrumentation, Communication and Lighting Cables with general purpose insulation and sheaths. Requirement of special sheaths with Fire Survival (FS) and Flame Retardant Low Smoke (FRLS) characteristics are also covered in this specification.

## **2.0     CODES AND STANDARDS**

- 2.1     The design, construction, manufacture and performance of cables shall comply with all currently applicable statutes, regulations and safety codes in the locality where cables will be installed. Nothing in this specification shall be construed to relieve the VENDOR of this responsibility.
- 2.2     Unless otherwise specified equipment shall conform to the latest applicable standards as on the date of tender submission unless otherwise indicated.

## **3.0     SPECIFICATIONS**

- 3.1     Power & Control Cables [ For Working Voltages Up To And Including 1100 V
- 3.1.1   Aluminium stranded conductor XLPE insulated armoured cables shall be used for main power supply purpose from LT Aux. Transformers to control room, between distribution boards and for supply for colony lighting from control room.
- 3.1.2   Aluminium stranded conductor PVC insulated armoured power cables shall be used for various other applications in switchyard area/control room except for control/protection purposes.
- 3.1.3   For all control/protection/instrumentation purposes PVC insulated armoured control cables of minimum 2.5 sq. mm. size with stranded Copper conductors shall be used.
- 3.1.4   KPTCL has standardised the sizes of power cables for various feeders. Bidders are to estimate the quantity of cables and quote accordingly. The sizes of power cables to be used per feeder in different application shall be as follows:

<b>Sl. No.</b>	<b>From</b>	<b>To</b>	<b>Cable Size</b>	<b>Cable type</b>
1	Main switch Board	LT Transformer	2Rx1Cx 630mm <sup>2</sup> / phase & 1Rx1Cx630mm <sup>2</sup> for neutral	XLPE
2	Main switch Board	AC Distribution Board	2Rx31/2Cx 300 mm <sup>2</sup>	XLPE
3	Main switch Board	Oil Filtration Unit	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 300 mm <sup>2</sup>	XLPE
4	Main switch Board	Colony Lighting	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 300 mm <sup>2</sup>	XLPE
5	Main switch Board	HVW pump LCP	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 300 mm <sup>2</sup>	XLPE
6	Main switch Board	Main Lighting distribution board	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 300 mm <sup>2</sup>	XLPE
7	AC Distribution Board	D.G. Set AMF panel	2Rx3 <sup>1</sup> / <sub>2</sub> Cx 300 mm <sup>2</sup>	XLPE
8	AC Distribution Board	Emergency Lighting distribution board	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 70 mm <sup>2</sup>	PVC
9	AC Distribution Board	Reactor MB	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 70 mm <sup>2</sup>	PVC
10	AC Distribution Board	Bay MB/ DFDB	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 70 mm <sup>2</sup>	PVC
11	Bay MB/ DFDB	AC Kiosk/	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 35 mm <sup>2</sup>	PVC
12	AC Distribution Board	Battery charger	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 70 mm <sup>2</sup>	PVC
13	DCDB	Battery	2Rx1C x 150 mm <sup>2</sup>	PVC
14	DCDB	Battery Charger	2Rx1C x 150 mm <sup>2</sup>	PVC
15	DCDB	Protection/PLCC panel	1Rx4C x 16 mm <sup>2</sup>	PVC
16	Main Lighting DB	Lighting Panels (Indoor)	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 35 mm <sup>2</sup>	PVC
17	Main Lighting DB	Lighting Panels (Outdoor)	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 70 mm <sup>2</sup>	PVC
18	Main Lighting DB	Receptacles (Indoor)	1-3 <sup>1</sup> / <sub>2</sub> C x 35 mm <sup>2</sup>	PVC
19	Main Lighting DB	Receptacles (Outdoor)	1Rx3 <sup>1</sup> / <sub>2</sub> Cx 70 mm <sup>2</sup>	PVC
20	Lighting Panel	Sub lighting panels	1Rx4C x 16 mm <sup>2</sup>	PVC

			mm <sup>2</sup>	
21	Lighting Panel	Street Lighting Poles	1Rx4C x 16 mm <sup>2</sup>	PVC
22	Lighting Panel / Sub lighting panels	Lighting Fixtures (Outdoor)	1Rx2C x 2.5 mm <sup>2</sup> (Copper)	PVC
23	Bay MB/ DFDB	Equipments	1Rx4C x 6/4 mm <sup>2</sup> (Copper)	PVC

3.1.5 Bidder may offer sizes other than the sizes specified in clause 3.1.4. In such case and for other application where sizes of cables have not been indicated in the specification, sizing of power cables shall be done keeping in view continuous current, voltage drop & short-circuit consideration of the system. Relevant calculations shall be submitted by bidder during detailed engineering for purchaser's approval.

3.1.6 The successful bidder has to finalize the cable schedules based on the site conditions and the schemes quoted, which are to be approved by owner payment for control and power cables will be made quantities of both power and control cables indicated in the bid proposal sheets and quantities finalized as per cable schedules whichever is lower.

3.1.7 Cables shall be laid conforming to IS: 1255.

3.1.8 While preparing cable schedules for control/protection purpose following shall be ensured:

a) Separate cables shall be used for AC & DC.

b) Separate cables shall be used for DC1 & DC2.

3.1.9 For different cores of CT & CVT separate cable shall be used

3.1.10 Atleast one (1) cores shall be kept as spare in each copper control cable of 4C, 5C or 7C size whereas minimum no. of spare cores shall be two (2) for control cables of 10 core or higher size.

3.1.11 For control cabling, including CT/VT circuits, 2.5 sq. mm. size copper cables shall be used per connection. However, if required from voltage drop/VA burden consideration higher size / additional cores shall be used. Further for potential circuits of energy meters separate connections by 2 cores of 2.5 sq.mm. size shall be provided.

3.1.12 Standard technical data sheets for cable sizes up to and including 1100V are indicated in specifications. Cable sizes shall be offered/manufactured in accordance with parameters specified in standard technical data sheets. Technical data sheet for any other cores/sizes required during detailed engineering shall be separately offered for owner's approval by the contractor/supplier.

3.1.13 General:

- a) The cables shall be suitable for laying in racks, ducts, trenches, conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.
- b) They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions. The XLPE /PVC insulated L.T. power cables of sizes 240 sq. mm. and above shall withstand without damage a 3 phase fault current of at least 45 kA for at least 0.12 second, with an initial peak of 105 kA in one of the phases at rated conductor temperature ( 70°C for PVC insulated cables and 90°C for XLPE insulated cables). The armour for these power cables shall be capable of carrying 45 kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.
- c) The XLPE insulated cables shall be capable of withstanding a conductor temperature of 250°C during a short circuit without any damage. The PVC insulated cables shall be capable of withstanding a conductor temperature of 160°C during a short circuit.
- d) The Aluminium/Copper wires used for manufacturing the cables shall be true circular in shape before stranding and shall be uniformly good quality, free from defects. All Aluminium used in the cables for conductors shall be of H2 grade. In case of single core cables armours shall be of H4 grade Aluminium.
- e) The fillers and inner sheath shall be of non-hygroscopic, fire retardant material, shall be softer than insulation and outer sheath shall be suitable for the operating temperature of the cable.

- f) Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of all cables.
- g) Strip wire armouring method (a) mentioned in Table 5, Page-6 of IS : 1554 (Part 1) shall not be accepted for any of the cables. For control cables only round wire armouring shall be used.
- h) The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.
- i) All the cables shall pass fire resistance test as per IS:1554 (Part-1).
- j) The normal current rating of all PVC insulated cables shall be as per IS:3961.
- k) Repaired cables shall not be accepted.
- l) Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

#### 3.1.14 XLPE Power Cables

- a) The XLPE (90°C) insulated cables shall be of FRLS type, C2 category conforming to IS: 7098 (Part-1) and its amendments read along with this specification.
- b) The conductor shall be stranded aluminium, for cable size greater than 6mm<sup>2</sup> whereas copper for 6mm<sup>2</sup> or lesser and circular/sector shaped and compacted.
- c) In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables.
- d) For XLPE cables, the inner sheath shall be of extruded PVC of type ST-2 of IS:5831.
- e) When armouring is specified for single core cables, the same shall consist of aluminium wires/strips.

- f) The outer sheath shall be extruded PVC of Type ST-2 of IS:5831 for all XLPE cables.

#### 3.1.15 PVC Power Cables

- a) The PVC (70°C) insulated 1100V grade power cables shall be of FRLS type, C2 category, conforming to IS: 1554 (Part-1) and its amendments read along with this specification and shall be suitable for a steady conductor temperature of 70°C.
- b) The conductor shall be stranded aluminium, for cable size greater than 6mm<sup>2</sup> whereas copper for 6mm<sup>2</sup> or lesser sizes.
- c) The Insulation shall be extruded PVC to type-A of IS: 5831.
- d) A distinct inner sheath shall be provided in all multicore cables. For multicore armoured cables, the inner sheath shall be of extruded PVC.
- e) The outer sheath shall be extruded PVC to Type ST-1 of IS: 5831 for all cables.

#### 3.1.16 PVC Control Cables

- a) The PVC (70°C) insulated 1100V grade control cables shall be of FRLS type C2 category conforming to IS: 1554 (Part-1) and its amendments, read along with this specification.
- b) The conductor shall be stranded copper. The insulation shall be extruded PVC to type A of IS: 5831. A distinct inner sheath shall be provided in all cables whether armoured or not.
- c) The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be grey in colour.
- d) Cores shall be identified as per IS: 1554 (Part-1) for the cables up to five (5) cores and for cables with more than five (5) cores the identification of cores shall be done by printing legible Hindu Arabic Numerals on all cores as per clause 10.3 of IS 1554 (Part-1).

#### 3.1.17 Telecommunication Cables

The cables shall meet the following requirements :

- a) Conductor: Solid, tinned, annealed copper



- b) Insulation: PVC insulation type-A as per IS 5831
- c) Twisting: The insulated conductors shall be twisted together to form twisted pairs or quads, these shall be stranded in concentric layers to form the cable core. The cable thus formed shall be tightly lapped with outer wrapping tapes.

The interstices of insulated cable core shall be completely filled with viscose compound.

- d) Overall: With 0.075 mm aluminium tape or 0.013 mm melinex screening tape, overlap not less than 30%.
- e) Other details: A suitable non-magnetic rip cord shall be laid detailslongitudinally under the sheath. The armouring shall be of galvanised steel wires or galvanised single steel strip. The inner PVC sheath shall be of type-A. The outer PVC sheath shall be of Type ST-1.
- f) Voltage tests for: Dielectric withstand between conductors - 500V for 1 minute (rms) and between conductor & sheath - 2000V rms/3000 V DC.

The construction, performance and testing of the cable shall comply generally with the following standards :

- i. IEC 189-1 (Low frequency cables and wires with PVC insulation and sheath - General Tests and measuring methods)
- ii. IEC 189-2 (-do- Cables in pairs, triples, quadruples and quintuples).

#### 3.1.18 1100 V Grade Lighting/Misc./Light duty unarmoured cables

Cables shall be insulated with extruded PVC type-C. Outer sheath shall be extruded black PVC type ST-1. The sheathed cables shall be weather proof suitable for indoor/outdoor use. Twin and multicore cables shall be laid up and filled with thermoplastic material, bound by plastic tape and provided with outer sheath.

The construction, performance and testing of the cable shall comply with IS 694 (PVC insulated cables for working voltages up to and including 1100 V).

### 3.1.19 Instrumentation Cables

The cables shall comply with the following requirements :

Conductor	:	Annealed, tinned copper in solid or stranded circular construction
Insulation	:	PVC type-A applied by extrusion process. The insulation shall be strippable manually as well as by mechanical stripping devices without damage to the conductor.
Element identification	:	As per IEC-189-2
Core wrapping taping or by	:	By non hygroscopic material by extrusion
Element screening	:	By copper tape of minimum 0.04 mm thickness or by copper laminated plastic tape when specified in Data Sheet.
Rip cord	:	Non metallic rip cord under the core wrapping
Drain wire	:	A tinned copper drain wire of minimum 0.5mm <sup>2</sup> cross section in contact with each screen of cabling element.

Cabling elements shall be any one of the following :

A 'Pair' of two insulated conductors twisted together designated by alphabet 'p' printed on a binding tape at 200 mm intervals.

A 'Triad' of three insulated conductors twisted together designated by alphabet 't', printed on a binding tape at 200 mm intervals.

A 'Quad' of four insulated conductors twisted together and designated by alphabet 'q' printed on a binding tape at 200 mm intervals.

A 'Quintuple' of five insulated conductors twisted together or by combination of one quad & one untwisted wire or 2 pairs and one

untwisted wire. The quintuple shall be designated by alphabet 'Q' printed on a binding tape at 200 mm interval.

Maximum length of lay in the finished cable shall be 120 mm.

#### Units

Cables shall be bunched together in units of twenty cabling elements or sub units of five or ten elements, stranded in concentric layers. The units or sub units shall be designated by p1, p2, p3,..., t1, t2, t3..., q1, q2, q3, .., or Q1, Q2, Q3 ..., etc. depending on the combination.

#### Overall screening and armouring

Cables shall have an overall screen made up of copper/aluminium tape of 0.04 mm thickness or copper/aluminium of 0.008 mm thickness laminated with plastic tape with a minimum overlap of 15%. A drain wire of tinned copper with minimum 0.5 mm<sup>2</sup> cross section shall be provided in continuous contact with the screen. Armouring when specified shall be of galvanised steel strips.

#### Inner and Outer Sheath

The inner and outer sheaths shall consist of black PVC compound Type ST-1.

Voltage grade - Dielectric between conductors shall withstand for 1 minute the following voltages :

- a) Conductor diameter upto 0.6 mm - 1000 V AC or 1500 V DC
- b) Conductor diameter above 0.6 mm- 1500 V AC or 2250 V DC

#### Insulation Resistance

Minimum insulation resistance per km shall be 500 mega Ohm.

#### Mutual Capacitance

Mutual capacitance of any pair of conductors shall not exceed 120nF/km.

#### Capacitance Unbalance

The capacitance unbalance between any two pairs shall not exceed 400 pF for 500 metre length of cable.

The construction, performance and testing of cables except as modified above shall generally comply with the following standards :

IEC-189 - Part-1 : Low frequency cables and wires with PVC insulation and sheath. General test and measuring methods

IEC-189 - Part-2 : (-do- Cables in pairs, triples, quads and quintuples).

### 3.2 HV Power Cables [For Working Voltages From 3.3 kV and including 33 kV]

#### 3.2.1 HV power cable for auxiliary power supply

- a) The HV cable of 1Cx185 mm<sup>2</sup> (Aluminium Conductor) or 1Cx120mm<sup>2</sup> (Copper Conductor) of voltage class as specified for 630 kVA LT transformer for interconnecting 630kVA LT transformer to the KPTCL / ESCOM feeder shall be, XLPE insulated, armoured cable conforming to IS 7098 (Part-2) or IEC 60502-2 1998. Terminating accessories shall conform to IS 17573-1992 or IEC 61442-1997/IEC60502-4 1998.
- b) The HV cable of 3Cx95 mm<sup>2</sup> (Aluminium Conductor) or 3Cx70mm<sup>2</sup> (Copper Conductor) of voltage class as specified for 250kVA LT transformer for interconnecting 250kVA LT transformer to the KPTCL / ESCOM feeder shall be, XLPE insulated, armoured cable conforming to IS 7098 (Part-II) or IEC 60502-2 1998. Terminating accessories shall conform to IS 17573-1992 or IEC 61442-1997/IEC60502-4 1998.
- c) Only overhead connection has been foreseen for interconnecting 1MVA, LT transformer to the tertiary of the ICT. However, HV cable connections in place of overhead connection, if necessary shall also be in the scope of contractor. In this case contractor shall provide 1C x 185 mm<sup>2</sup> (Aluminium Conductor) or 1Cx120mm<sup>2</sup> (Copper Conductor), 38/66kV HV cable along with necessary terminating accessories. The construction of XLPE insulated, armoured HV cable shall be generally conforming to IS 7098 (Part-III). Terminating accessories shall conform to IEC60840 1999

- d) Bidder may offer sizes other than the sizes specified in clause 3.2.1 (a) and (b). In such case sizing of power cables shall be done keeping in view continuous current, voltage drop & short-circuit consideration of the system. Relevant calculations shall be submitted by bidder during detailed engineering for purchaser's approval.

### 3.2.2 Constructional Requirements

Cable shall have compacted circular Aluminium conductor, Conductor screened with extruded semi conducting compound, XLPE insulated, insulation screened with extruded semi conducting compound, armoured with non-magnetic material, followed by extruded PVC outer sheath (Type ST-2), with FRLS properties.

- 3.2.3 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of the cable.
- 3.2.4 The cables shall have outer sheath of a material with an Oxygen Index of not less than 29 and a Temperature index of not less than 250°C.
- 3.2.5 Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

## 4.0 CABLE DRUMS

- 4.1 Cables shall be supplied in returnable wooden or steel drums of heavy construction. Wooden drum shall be properly seasoned sound and free from defects. Wood preservative shall be applied to the entire drum.
- 4.2 Standard lengths for each size of power and control cables shall be 500/1000 meters. The cable length per drum shall be subject to a tolerance of plus or minus 5% of the standard drum length. The owner shall have the option of rejecting cable drums with shorter lengths. Maximum, One (1) number non standard length of cable size(s) may be supplied in drums for completion of project.
- 4.3 A layer of water proof paper shall be applied to the surface of the drums and over the outer most cable layer.

- 4.4 A clear space of at least 40 mm shall be left between the cables and the lagging.
- 4.5 Each drum shall carry the manufacturer's name, the purchaser's name, address and contract number and type, size and length of the cable, net and gross weight stenciled on both sides of drum. A tag containing the same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.
- 4.6 Packing shall be sturdy and adequate to protect the cables, from any injury due to mishandling or other conditions encountered during transportation, handling and storage. Both cable ends shall be sealed with PVC/Rubber caps so as to eliminate ingress of water during transportation and erection.

5.0 **REQUIREMENT OF SPECIAL SHEATH FOR FRLS/FS CABLE**

Outer sheath for FRLS/FS (when specified) cables shall meet the following test requirements related to flame retardance, low smoke emission, low acid and toxic gas emission. The BIDDERS shall have proper test apparatus to conduct all the relevant tests as per the applicable Standards mentioned herein.

5.1 **Test for Flame Retardance**

(a) **Oxygen Index**

The critical oxygen index value shall be minimum 29 when tested at  $27 \pm 2^\circ\text{C}$  as per ASTM-D-2863 and the temperature index value shall be minimum  $250^\circ\text{C}$  at oxygen index of 21 when tested as per ASTM-D-2863/NES 715.

(b) **Flammability**

- i. Cables shall pass test under fire conditions as per IS-10810-Part-53.
- ii. Cables shall also pass tests as per IS-10810 Part-61 & Part-62.
- iii. Fire survival cables in addition to tests (i) and (ii) above shall pass tests as per IEC-331.

- iv. For Cables which pass test as per IEC-332, IEEE-383, and Swedish chimney test F3 as per SS 424-1475.

5.2 Test for Smoke Generation

The cables shall satisfy the tests conducted to evaluate the percentage obscuration by smoke in an optical system placed in the path of the smoke. The minimum light transmittance rating shall not be less than 60% when tested as per IEC61034.

5.3 Tests for Acid Gas Generation

The hydrochloric acid generation when tested as per IEC 754-1 shall be less than 20% by weight.

5.4 Tests for Resistance to Ultra Violet Radiation

This test shall be carried out as per DIN 53387. The retention values of tensile strength and ultimate elongation after the tests shall be minimum 60% of tensile strength and ultimate elongation before test.

5.5 Tests for Water Absorption

Outer sheathes shall be subjected to tests for water absorption as per IS 10810. When additional characteristics are required, the tests shall be as applicable in Section-C or as agreed to between PURCHASER and VENDOR before the placement of order.

- 5.6 Anti-rodent and termite repulsion test 5.6 Any other special tests on the sheath in addition to the above shall be as specified in specifications.

**6.0 TYPE TESTS**

- 6.1 All cables shall conform to all type, routine and acceptance tests listed in the relevant IS.

Type tested Cables shall be offered. The type test reports shall not be older than ten (10) years as on the last date of submission of bid.

**a) For Power and Control Cables manufactured in India:**

- i). The type tests on indigenous equipment for which testing facility is available in India, should have been conducted in any independent laboratories approved by the Government or the laboratories accredited by the National accreditation body

- of the country like Central Power Research Institute (CPRI), Electrical Research and Development Association (ERDA), etc.
- ii). The type tests on indigenous equipment, for which testing facility is not available in India, should have been conducted in a laboratory of foreign country accredited by National accreditation body of that country.
  - iii). The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of NABL accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

**b) For Power and Control Cables manufactured Abroad:**

- i). Type tests on imported equipment should have been conducted in an Indian Laboratory or foreign laboratory accredited by National accreditation body of the country where the Type test has been conducted.
- ii). The type tests conducted in-house by a manufacturer shall also be acceptable provided the laboratory is accredited by National accreditation body of the country and the tests has been conducted in the presence of a representative of accredited laboratory or any of the purchasing utilities or CEA in that order. Such type test reports shall record the details of such witness including the signature/authentication in the type test report.

In case of in-house type tested imported equipment of foreign OEM, the term “Purchasing Utility” covers the foreign Utility who has purchased that equipment.

**6.2 XLPE insulated power cables ( For working voltages up to and including 1100V ):-**

6.2.1 Following type tests ( on one size in a contract) as per IS: 7098 (Part 1) – 1988 including its amendments shall be carried out as a part of acceptance tests on XLPE insulated power cables for working voltages up to and including 1100 V:

- a) Physical tests for insulation
  - i) Hot set test
  - ii) Shrinkage test



b) Physical tests for outer sheath

- i) Shrinkage test
- ii) Hot deformation
- iii) Heat shock test
- iv) Thermal stability

6.2.2 Contractor shall submit type test reports for the following tests-

- a) Water absorption (gravimetric) test
- b) Ageing in air oven
- c) Loss of mass in air oven
- d) Short time current test on power cables of sizes 240 sqmm and above on
  - i) Conductors.
  - ii) Armours.
- e) Test for armouring wires/strips.
- f) Oxygen and Temperature Index test.
- g) Flammability test.
- h) Smoke density tests
- i) Test for Halogen acid gas evolution

**6.3 PVC INSULATED POWER & CONTROL CABLES (For working voltages up to and including 1100V)-**

6.3.1 Following type tests ( on one size in a contract) as per IS: 1554 (Part 1) including its amendments shall be carried out as a part of acceptance tests on PVC insulated power & control cables for working voltages up to and including 1100 V:

a) Physical tests for outer sheath

- i) Shrinkage test

- ii) Hot deformation
- iii) Heat shock test
- iv) Thermal stability
- b) High voltage test (water immersion test only a.c. test as per clause no. 16.3.1).

6.3.2 Contractor shall submit type test reports for the following-

- a) High voltage test (water immersion d.c. test as per clause no. 16.3.2 of IS: 1554 (Part 1)).
- b) Ageing in air oven.
- c) Loss of mass in air oven.
- d) Short time current test on power cables of sizes 240 sqmm and above on
  - i) Conductors.
  - ii) Armours.
- e) Test for armouring wires/strips.
- f) Oxygen and Temperature Index test.
- g) Flammability test.
- h) Smoke density tests
- i) Test for Halogen acid gas evolution

**6.4 XLPE insulated HV power cables( For working voltages from 3.3 kV and including 33 kV)-**

Contractor shall submit type test reports for XLPE insulated HV power cables ( as per IS 7098 Part-II including its amendment or as per IEC).

**STANDARD TECHNICAL DATA SHEET  
(1.1kV GRADE XLPE POWER CABLES)**

SN	CUSTOMER:	KPTCL	
	Name of manufacturer	As per approved list	
	<b>Cable Sizes</b>	<b>1C x 630</b>	<b>3<sup>1/2</sup> C x 300</b>
1	Manufacturer's type designation	A2XWaY	A2XWY
2	Applicable standard	IS:7098/PT-1/1988 & its referred specifications	
3	Rated voltage (volts)	1100V grade	
4	Type & Category	FRLS & C2	FRLS & C2
5	Suitable for earthed or unearthed system	For both	
6	Continuous current rating when laid in air in a ambient temp. of 50°C and for maximum conductor temp. of 70°C of PVC Cables (For information only)	732	410
7	Ration factors applicable to the current ratings for various conditions of installation.	As per IS-3961-Pt-II-67	
8	Short Circuit capacity		
	a). Guaranteed short circuit Amp. (rms) KA for 0.12sec duration at rated conductor temperature of 90 degree C, with an initial peak of 105kA.	45kA	45kA
	b). Maximum conductor temp. allowed for the short circuit duty (deg. C) as stated above.	250°C	
9	Conductor		
	a). Material	Standard Aluminium as per class 2 of IS: 8130	
	b). Grade	H2 (Electrolytic grade)	
	c). Cross section area (Sq.mm)	630	300/150
	d). Number of wires (No.) minimum	53	30/15
	e). Form of conductor	Standard and compacted circular	Standard compacted circular/sector shaped
	f). Direction of lay of stranded layer	Outermost layer shall be R.H. lay & opposite in successive layers	
10	Conductor resistance (DC) at 20°C per km – maximum	0.0469	0.1/0.206
11	Insulation		
	a). Composition of insulation	Extruded XLPE as per IS-7098 Part (1)	
	b). Nominal thickness of insulation (mm)	2.8	1.8/1.4
	c). Minimum thickness of	2.42	1.52/1.16

	insulation		
12	Inner Sheath		
	a) material	Extruded PVC type ST-2 as per IS-5831-84	
	b). Calculated diameter over the laid up cores, (mm)	NA	52
	c). Thickness of sheath (minimum) mm	NA	0.6
	d). Method of extrusion	NA	Pressure/Vacuum extrusion
13	Armour		
	a). Type and material of armour	Al. Wire (H4 grade)	Gal. Steel wire
	b). Direction of armouring	Left hand	
	c). Calculated diameter of cable over inner sheath (under armour), mm	33.9	53.2
	d). Nominal diameter of round armour wire (minimum)	2	2.5
	e). Guaranteed short circuit capacity of the armour for 0.12 sec at room temperature	45kA	45kA
	f). DC resistance at 20°C ( $\Omega$ /Km)	\$	0.577
14	Outer sheath		
	a). Material (PVC Type)	ST-2 & FRLS	ST-2 & FRLS
	b). Calculated diameter under the sheath	38.3	59.50
	c). Min. thickness of sheath (mm)	1.72	2.36
	d). Guaranteed value of minimum oxygen index of outer sheath at 27°C	Min 29.0	Min 29.0
	e). Guaranteed value of minimum temperature index at 21 oxygen index	Min. 250	Min. 250
	f). Colour of sheath	Black	Black
15	a). Nominal Overall diameter of cable	\$	\$
	b). Tolerance of overall diameter (mm)	+2/-2 mm	
16	Cable Drums	Shall conform to IS 10418 and technical specification	
	a). Max./standard length pr drum for each size of cable (single length) with $\pm 5\%$ Tolerance (mtrs)	1000/500	1000/500
	b). Non standard drum lengths	: Maximum one(1) non standard lengths of each cable size may be supplied in drums only over and above the standard lengths as specified above. (If required for completion of project).	
17	Whether progressive sequential marking on outer sheath provided	Yes	

	at 1 meter interval	
18	Identification of cores	
	a). Colour of cores	As pr IS 7098 Part (1)
	b). Numbering	N.A.
19	Whether cables offered are ISI marked	Yes
20	Whether cables offered are suitable for laying as pr IS 1255	Yes

**\$ - As per manufacturer design data**

**STANDARD TECHNICAL DATA SHEET  
(1.1kV GRADE PVC POWER CABLES)**

	<b>CUSTOMER:</b>	<b>KPTCL</b>					
<b>SN</b>	<b>Name of manufacturer</b>	<b>As per approved list</b>					
	<b>Cable Sizes</b>	<b>1 C x 150</b>	<b>3.5 C x 70</b>	<b>3.5 C x 35</b>	<b>4 C x 16</b>	<b>4 C x 6</b>	<b>2 C x 6</b>
1	Manufacturer's type designation	AYWaY	AYFY	AYFY	AYFY	AYWY	AYWY
2	Applicable standard	IS: 1554/PT-1/1988 & its referred standards					
3	Rated voltage (volts)	1100V grade					
4	Type & Category	FRLS & C2	FRLS & C2	FRLS & C2	FRLS & C2	FRLS & C2	FRLS & C2
5	Suitable for earthed or unearthed system	For both					
6	Continuous current rating when laid in air in a ambient temp. of 50°C and for maximum conductor temp. of 70°C of PVC Cables (For information only)	202	105	70	41	24	28
7	Ration factors applicable to the current ratings for various conditions of installation.	As per IS – 3961 – Pt-II-67					
8	Short Circuit capacity						
	a). Guaranteed short circuit Amp. (rms) KA for 0.12sec duration at rated conductor temperature of 90 degree C, with an initial peak of 105kA.	11.2	5.22	2.61	1.19	0.448	0.448
	b). Maximum conductor temp. allowed for the short circuit duty (deg. C) as stated above.	160°C					
9	Conductor						
	a). Material	Standard Aluminium					

	b). Grade	H2 (Electrolytic grade)					
	c). Cross section area (Sq.mm)	150	M-70 N-35	M-35 N-16	16	6	6
	d). Number of wires (No.) minimum	As per Table 2 of IS 8130					
	e). Form of conductor	Non-compacted standard circular	Shaped conductor	Shaped conductor	Shaped conductor	Non-compacted stranded circular	Non-compacted stranded circular
	f). Direction of lay of stranded layer	Outermost layer shall be R.H. lay & opposite in successive layers					
10	Conductor resistance (DC) at 20°C per km - maximum	0.206	0.443 /0.868	0.868 /1.91	1.91	4.61	4.61
11	Insulation						
	a). Composition of insulation	Extruded PVC type A as per IS-5831-84					
	b). Nominal thickness of insulation (mm)	2.1	1.4/1.2	1.2/1.0	1.0	1.0	1.0
	c). Minimum thickness of insulation	1.79	1.16/0.98	0.98/0.8	0.8	0.8	0.8
12	Inner Sheath						
	a) material	Extruded PVC type ST-1 as per IS-5831-84					
	b). Calculated diameter over the laid up cores, (mm)	N.A	27.6	20.4	15.7	11.6	9.6
	c). Thickness of sheath (minimum) mm	N.A	0.4	0.3	0.3	0.3	0.3
13	Armour	As per IS 3975/88					
	a). Type and material of armour	Al. Wire (H4 grade)	Gal. steel strip	Gal. steel strip	Gal. steel strip	Gal. steel wire	Gal. steel wire
	b). Direction of armouring	Left hand					
	c). Calculated diameter of cable over inner sheath (under armour), mm	18	28.4	21	16.3	12.2	10.2
	d). Nominal diameter of round armour wire (minimum)	1.6	4 x 0.8	4 x 0.8	4 x 0.8	1.4	1.4
	e). No. of Armour wires/stripes	Armouring shall be as close as practicable					
	f). Short circuit capacity of the armour along for 1 second – for info. Only	$K \times A \sqrt{t}$ (K Amp) (where A = total area of armour in mm <sup>2</sup> & t = time in seconds), K=0.091 for Al. & 0.05 for steel					

	g). DC resistance at 20°C ( $\Omega/\text{Km}$ )	0.44	2.57	3.38	3.99	3.76	4.4
14	Outer sheath						
	a). Material (PVC Type)	ST-1 & FRLS	ST-1 & FRLS	ST-1 & FRLS	ST-1 & FRLS	ST-1 & FRLS	ST-1 & FRLS
	b). Calculated diameter under the sheath	21.2	30.1	22.6	17.9	15	13
	c). Min. thickness of sheath (mm)	1.4	1.56	1.4	1.4	1.4	1.24
	d). Guaranteed value of minimum oxygen index of outer sheath at 27°C	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0	Min 29.0
	e). Guaranteed value of minimum temperature index at 21 oxygen index	Min 250	Min 250	Min 250	Min 250	Min 250	Min 250
	f). Colour of sheath	Black	Black	Black	Black	Black	Black
15	a). Overall diameter of cable	\$					
	b). Tolerance of overall diameter (mm)	+2/-2 mm					
16	Cable Drums	Shall conform to IS 10418 and technical specification					
	a). Max./standard length per drum for each size of cable (single length) with $\pm 5\%$	1000/500	1000/500	1000/500	1000/500	1000/500	1000/500
	Tolerance (mtrs)						
	b). Non standard drum lengths	Maximum one (1) non standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above. (If required for completion of project)					
17	Whether progressive sequential marking on outer sheath provided at 1 meter interval	YES					
18	Identification of cores						
	a). Colour of cores	Red	R,Y,Bl & Bk	R,Y,Bl & Bk	R,Y,Bl & Bk	R,Y,Bl & Bk	Red & Bk
	b). Numbering	N.A.					
19	Whether cables offered are ISI marked	YES					

20	Whether cables offered are suitable for laying as pr IS 1255	YES
----	--	-----

**\$ - As per manufacturer design data**



**TECHNICAL DATA SHEET  
(1.1kV GRADE PVC CONTROL CABLES)**

N	<b>CUSTOMER:</b>	<b>KPTCL</b>							
	<b>Name of manufacturer</b>	<b>As per approved list</b>							
	<b>Cable Sizes</b>	2C x 2.5	3C x 2.5	5C x 2.5	7C x 2.5	10Cx 2.5	14C x 2.5	19C x 2.5	27C x 2.5
	Manufacturer's type designation	YWY	YWY	YWY	YWY	YWY	YWY	YWY	YWY
	Applicable standard	IS: 1554/PT-1/1988 & its referred standards							
	Rated voltage (volts)	1100							
	Type & Category	FRLS & C2							
	Suitable for earthed or unearthed system	For both							
	Continuous current rating when laid in air in a ambient temp. of 50°C and for maximum conductor temp. of 70°C of PVC Cables (For information only)	22	19	19	14	12	10.5	9.7	8
	Ration factors applicable to the current ratings for various conditions of installation.	As per IS-3961-Pt-II-67							
	Short Circuit capacity								
	a). Short circuit Amp. (rms) KA for 1sec – for info. only	0.285	0.285	0.285	0.285	0.285	0.285	0.285	0.285
	b). Conductor temp. allowed	160°C							

	for the short circuit duty (deg. C).								
	Conductor								
	a). Material	Plain annealed High Conductivity stranded Copper (As pr IS 8130/84)							
	b). Grade	Electrolytic							
	c). Cross section area (Sq.mm)	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	d). Number of wires (No.)	As pr Table 2 of IS 8130							
	e). Form of conductor	Non-Compacted stranded circular conductor							
	f). Direction of lay of stranded layer	Outermost layer shall be R.H. lay							
0	Conductor resistance (DC) at 20°C per km - maximum	7.41	7.41	7.41	7.41	7.41	7.41	7.41	7.41
1	Insulation								
	a). Composition of insulation	Extruded PVC type A as per IS-5831-84							
	b). Nominal thickness of insulation (mm)	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
	c). Minimum thickness of insulation	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
2	Inner Sheath								
	a) material	Extruded PVC type ST-I as per IS-5831-84							
	b). Calculated diameter over the laid up cores, (mm)	7.2	7.8	9.7	10.8	14.4	15.9	18	22.1
	c). Thickness of sheath (minimum) mm	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
3	Armour	As per IS3975/99							
	a). Type and material of armour	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire	Gal. Steel wire
	b). Direction of armouring	Left land							
	c). Calculated diameter of	7.8	8.4	10.3	11.4	15	16.5	18.6	22.7



	diameter of cable								
	b). Tolerance of overall diameter (mm)	+2/-2 mm							
6	Cable Drums	Shall conform to IS 10418 and technical specification							
	a). Max./standard length pr drum for each size of cable (single length) with ±5% Tolerance (mtrs)	1000/500	1000/500	1000/500	1000/500	1000/500	1000/500	1000/500	1000/500
	b). Non standard drum lengths	Maximum one (1) non standard lengths of each cable size may be supplied in drums only over & above the standard lengths as specified above. (If required for completion of project)							
7	Whether progressive sequential marking on outer sheath provided	YES							
8	Identification of cores								
	a). Colour of cores	R & Bk	R, Y & Bl	R, Y, Bl, Bk & Grey	Grey	Grey	Grey	Grey	Grey
	b). Numbering	N.A	N.A	N.A	Numerals in black ink	Numerals in black ink	Numerals in black ink	Numerals in black ink	Numerals in black ink
9	Whether cables offered are ISI marked	YES							
10	Whether cables offered are suitable for laying as pr IS 1255	YES							

**\$ - As per manufacturer design data**

**DATA TO BE FURNISHED BY THE VENDOR  
AFTER THE AWARD OF CONTRACT**

**TECHNICAL DATA –** Following additional data for Information shall be furnished by the VENDOR for all cables, within two weeks from placement of letter of intent or order.

1.0 Continuous current rating of the cable

- a) In ground at soil temperature 30°C and soil thermal resistivity of 150°C cm/watt and depth of burial about a metre A
- b) In air at 40°C A
- c) Overload capacity and duration A, Hr
- d) Derating Factors for :
  - i) Soil temperature and thermal resistivity
  - ii) Ambient temperature
  - iii) Single core cables laid in trefoil circuits

2.0 General Technical Data (Power cables)

- 2.1 Equivalent star impedance per km of 3 Ph, circuit at power frequency at maximum conductor temperature Ohm
- 2.2 Maximum electrostatic capacitance per core per km of cable F
- 2.3 Maximum charging current per conductor per km at nominal voltage A
- 2.4 Loss tangent at normal frequency and rated voltage
- 2.5 Maximum dielectric loss of cable per km at normal voltage and frequency Watts/km
- 2.6 Short circuit capacity for 1 Sec. KA (rms)
- 2.7 Short Circuit current capacity of armour kA for 1 sec
- 2.8 Maximum dielectric stress at core screen kV/cm
- 2.9 Maximum overall dia. of cable mm

3.0 Construction details including type of material used and thickness of each material for each type of cable in a tabular form.

4.0 Instruction Manuals

4.1 When indicated in Section C specified number of copies of instruction manuals, descriptive bulletins etc. as indicated in the distribution schedule shall be furnished prior to despatch of cables. The manual shall include amongst others, the following particulars :

4.1.1 General information.

4.1.2 Principal technical data.

4.1.3 Description of insulation, sheathing and screening. This should include data on resistance to attack by chemicals, fungus, termites, rodents, water and ultra-violet radiation.

4.1.4 Installation and termination instructions.

5.0 Test Certificates

5.1 Type/Routine test certificates for all types of cables included in the order and special tests on FRLS/FS cables in line with applicable IS.

6.0 Any other information specifically called for by PURCHASER or CONSULTANT subsequent to order.

**7.0 DATA FOR APPROVAL**

7.1 Technical particulars of all cables

7.2 Cross section of all cables

7.3 QAP for all cables