SINGRAULI STPP STAGE-I & II (5X200MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE
and
VINDHYACHAL STPP STAGE-I & II (6X210MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE

TECHNICAL SPECIFICATION

FOR

1100V LT VFD POWER CABLES (XLPE)

BHARAT HEAVY ELECTRICALS LIMITED

INDUSTRIAL SYSTEMS GROUP – BANGALORE

Note: - In case any clarification is required, with regard to technical specification, please contact us over Email: psa@bhel.in (or) hemant.udupa@bhel.in

SIGN		SIGN		SIGN	
NAME	PULI SATYANARAYANA	NAME:	HEMANTHA UDUPA	NAME:	MALATHI D
DESIGNATION	DY.MANAGER		SR.MANAGER		Dy.GM
PREPARED BY		CHECKED BY		APPROVED BY	

CONTENTS

SECTION - I

1.0 GENERAL SITE INFORMATION

PROJECT : VINDHYACHAL SUPER THERMAL POWER PROJECT STAGE – I (6X210MW)

Vindhyachal Super Thermal Power Project (VSTPP) has operating capacity of 3260MW comprising of Stage – I (6X210MW), Stage – II (2X500MW), Stage – III (2X500MW), and two units of 500MW in Stage – IV is under construction.

PROJECT : SINGRAULI SUPER THERMAL POWER PROJECT STAGE – I (5X200MW)

Singrauli Super Thermal Power Project (SSTPP) has operating capacity of Stage – I (5X200MW), Stage – II (2X500MW)

Environmental Conditions: All equipments & accessories shall be suitable for conductive dusty laden corrosive atmosphere normally experienced in Power Plants and all equipments & accessories shall be designed to resist vermin , fungus, dew etc.

SECTION - II
APPLICABLE STANDARDS

All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages up to and including 1100V
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables
IS : 5831	PVC insulation and sheath of electrical cables
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100V
IS : 8130	Conductors for insulated electrical cables and flexible cords
IS : 10418	Specification for drums for electric cables
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B)

SECTION - III
SCOPE OF SUPPLY

3.1 Scope of supply includes design, manufacturing, testing, inspection, packing and dispatch to site

i) LT Power cables shall be 1100V Grade, stranded circular annealed bare copper conductor, Extruded XLPE insulated, metallic screened, Extruded PVC innersheathed,Galavnised steel round wire armoured, Extruded FRLS PVC outer sheathed, round and symmetrical with three symmetrically positioned insulated grounding conductors. The metallic screen of each core shall consist of copper wires or tape with minimum overlap of 20%.

3.2 BILL OF QUNATITY (BOQ) –

Sl. No.	Cable Size	Description	Length of cable (In Mtrs.)
	FOR SINGRAULI PROJECT		
1	(3C X6 +3C X 6/3) sq.mm CU Cable (**Armoured**)	LT Power cables shall be 1100V Grade, stranded circular annealed bare copper conductor, Extruded XLPE insulated, metallic screened, Extruded PVC innersheathed,Galavnised steel round wire armoured, Extruded FRLS PVC outer sheathed, round and symmetrical with three symmetrically positioned insulated grounding conductors. The metallic screen of each core shall consist of copper wires or tape with minimum overlap of 20%.	1500 (Fifteen Hundred Meters)
	FOR VINDHYACHAL PROJECT		
2	(3C X6 +3C X 6/3) sq.mm CU Cable (**Armoured**)	LT Power cables shall be 1100V Grade, stranded circular annealed bare copper conductor, Extruded XLPE insulated, metallic screened, Extruded PVC innersheathed,Galavnised steel round wire armoured, Extruded FRLS PVC outer sheathed, round and symmetrical with three symmetrically positioned insulated grounding conductors. The metallic screen of each core shall consist of copper wires or tape with minimum overlap of 20%.	2000 (Two Thousand Meters)

Operational Requirements:

All the cables shall be suitable for high ambient, high humid tropical Indian climatic conditions. All the cables shall be designed to withstand the mechanical, electrical and thermal stresses under the foreseen steady state and transient / fault conditions, and shall be suitable for the proposed method of installation.

3.3: Length tolerance for individual drum shall be ± 5% and overall length tolerance shall be ± 2%.

SECTION - IV
TECHNICAL SPECIFICATIONS

4.1 GENERAL SPECIFICATIONS:

4.1.1 Type: 1100V Grade, Multi stranded circular annealed bare copper conductor, Extruded XLPE insulated, metallic screened, Extruded PVC Type ST-2 inner sheathed,Galavnised steel round wire armoured, Extruded FRLS PVC type ST-2 outer sheathed, round and symmetrical with three symmetrically positioned insulated grounding conductors confirming to relevant standards. The metallic screen of each core shall consist of copper wires or tape with minimum overlap of 20%.

4.1.2 Conductor: The conductor shall be made from high conductivity electrical grade plain annealed , stranded copper of class 2 as per IS 8130 – 1984 and circular shaped.

4.1.3 Insulation: The insulation shall be extruded XLPE confirming as per table-1 of IS:7098 (Part-1).XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

4.1.4 Inner Sheath : The inner sheath shall be made of extruded FRLS PVC compound over the laid up cores & shall conform to type ST2 (for FRLS properties) as per IS:5831. Cores shall be stranded together with suitable non-hygroscopic fillers in the interstices. Colour of inner sheath shall be Black.

4.1.5 Outer Sheath:

The outer sheath shall be made from extruded PVC compound with FRLS property conforming to the requirements of type ST2 of IS: 5831 & IS:7098 (part-1). (Polyethylene based halogen free compound not acceptable).Cores shall be stranded together with suitable non-hygroscopic fillers in the interstices. Colour of outer sheath should be Black.

The outer sheath of all the cables shall be of extruded layer of suitable synthetic material compatible with specified ambient and operating temperature of the cables. The outer sheath material of all cables shall be compatible with specified ambient and operating temperature of the cables. The sheath shall be resistant to water, UV radiation, fungus, termite and rodent attack.

4.1.6 Armouring: This shall be of galvanized round steel wire for multi core cables & Aluminum wire for single core cables as per IS : 3975 - 1988. Minimum coverage of 90%. Breaking load of joint shall be 95% of normal armour.

4.1.7 Cores identification: Cores identification shall be as per IS.

4.1.8 The inner & outer sheath of FRLS PVC compound shall meet the following performance requirements.

a) Oxygen index of min. 29 (as per IS 10810 Part-58)

b) Acid gas emission of max. 20% (as per IEC-754-I)

c) Smoke density rating shall not be more than 60 % (as per ASTMD-2843)

4.1.9 The finished cable shall pass the flammability test as per IEC-332 Part-3 (category-B)

4.1.10 Cable Marking :

- Cable size and Voltage grade (by embossing)
- Word " FRLS " @ 5 m (by embossing)
- Project name "----------" by printing
- Sequential marking of length of the cable in meters at every one meter - To be embossed / printed
- Manufacturer name & year of Manufacturing by printing.
- The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

4.2.0 Packing & Marking:

The cable shall be wound on a wooden/Steel drum of suitable size. Cable drums shall be manufactured as per IS: 10418 and supplied in non - returnable wooden/steel drums. The wood used for construction of the drum shall be properly seasoned and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with suitable rust preventive coating to avoid rusting during transit or storage. The cut end of the cable shall be sealed by means of a non- Hygroscopic sealing material.

The packing shall carry the following information stenciled on the drum and also contain in label attached to it. The label shall be of anodized aluminium and shall be fixed on both sides of drum.

a) BHEL- ISG
b) Manufacturer's name, brand name or trade mark
c) Reference to the Indian Standard
d) Drum identification no.
e) Type of cable, No of cores and voltage grade
f) Nominal Cross Sectional area of the conductor
g) Length of cable on the drum
h) Direction of rotation of the drum (by means of arrow)
i) Approximate Gross weight
j) Year of Manufacture

The drum shall also be marked with ISI certification mark.

NOTE 1: Both the end seals of cable shall positively prevent the entry of moisture /water during transportation / storage.

SECTION - V
QUALITY ASSURANCE, INSPECTION & TESTING

5.1 Testing shall be carried out strictly as per the Test Schedule given below. Supplier shall furnish the Manufacturing Quality Plan as per the enclosed format (i.e., Annexure-IV) duly signed for approval from Customer.

5.2 All equipment's / systems to be supplied shall confirm to type test as per relevant standards and proven type. *The supplier shall furnish the reports of all the type tests carried out within five years of the date of bid opening as per specification and relevant standards for each type and size of the cable supplied by the vendor. These reports should be for the tests conducted from any* ***government approved laboratory viz., CPRI/ ERDA/ NABL accredited laboratory*** *on the same cable size and specification of same voltage grade to be supplied under this contract.*

5.3 In case the supplier is not able to submit the reports of type test(s) conducted in the last five years, or in case of the type test report(s) are not found to be meeting the specification / relevant standard requirements, then all such test shall be conducted in the presence of the purchaser , under this contract by the supplier at free of cost to purchaser and reports shall be submitted for approval. Vendor shall conduct the type tests if the testing lab of the vendor is government accredited laboratory else same shall be conducted at third party govt. accredited laboratory at free of cost to BHEL –ISG.

5.4 **Schedule of Tests**

An indicative list of such tests is given below. This list of tests is not exhaustive and owner may ask for submission of test report of any other test as per standards. Apart from the below mentioned tests, all the other test (Routine, acceptance & type tests) as per IS and IEC shall be conducted on all the types of cables.

5.4.1 **Shop Tests**

The cables shall be subject to shop tests in accordance with relevant IS / IEC standards to prove the design and general qualities of the cables as below:

- Routine Tests
- Acceptance tests on drums chosen at random for acceptance of the lot.
- Type tests on each type of the cable, inclusive of measurement of armor DC resistance of power cables.

5.4.2 Additional tests

Following additional acceptance tests shall also be performed on each type of cables having outer sheath with improved fire performance.

- Oxygen index test – oxygen index shall not be less than 29.
- Temperature index test – measured value of temperature index shall be 21 at a temperature of 250°C
- Flame retardant test on single cable and on bunched cables.
- After the test, there should be no visible damages on the test specimen within 300mm from its upper end.

- After burning has ceased, the cables should be wiped clean and the charred or affected portion should not have reached a height exceeding 2.5 mtr above the bottom edge of the burner, measured at the front and rear of the cable assembly.
- Halogen acid gas evolution test- the level of acid shall not exceed 20% by weight.
- Smoke density test
- The cables shall meet the requirements of light transmission of minimum 40% after the test.
- Test for specific optical density of smoke
- Test for rodent & termite repulsion property
  The test shall be carried out to note the presence of rodent & termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solutions placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. a black spot indicates the presence of anti-termite & rodent compound.

NOTE 1: Both the end seals of cable shall positively prevent the entry of moisture / water during transportation / storage.

- **Following points shall be taken care by the bidder:**

  A) Bidder shall ensure that manufacturing & routine testing of all LT cables shall be from the works that have been already approved by NTPC.

  B) Bidder shall submit the manufacturing quality plan in line with NTPC already approved QAP (i.e., Annexure-IV) for previous project executed by bidder.

  C) Bidder has to supply the VFD Power Cables separately to two different projects (i.e., SINGAULI TPS and VINDHYACHAL TPS) as per the Quantity mentioned in BOQ (i.e., Clause No.3.2)

SECTION - VI
TECHNICAL DOCUMENTATION REQUIREMENT

Sl no.	Description	No of copies	Size	Time Schedule
1.	**After Purchase Order**			
	a) Catalogs	8	A4	Within 1 week from the date of PO
	b) Type test reports	4	A4	Within 1 week from the date of PO
	c) Internal test certificates	2	A4	With inspection call
	d) Test certificates	8	A4	Immediately after testing
	e) Storage Instructions for long period storage	8	A4	Immediately after dispatch
	f) Test Certificates	8	A4	Before dispatch of cable

NOTE: 1. Test Certificates shall be strictly in A4 size.
2. Test certificates shall have all the information as per IS including Drum no. and Drum length and overall diameter of the cable.
3. Test Certificates shall be marked " Certified" and shall be signed by Competent authority from supplier side.
4. All the documents shall have the following particulars.

- **Name of customer** : NTPC Limited
- **Job name** :
  1. SINGRAULI STPP STAGE-I & II (5X200MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE
  2. VINDHYACHAL STPP STAGE-I & II (6X210MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE
- **Contractor** : BHEL – ISG, Bangalore
- **Equipment Identification**: 1100V LT VFD Power Cables (XLPE)

Revised documents incorporating customer comments shall be re-submitted within 7days for approval. Delay in submission of documents and submission of revised documents shall be considered as delays and subject to delay calculation for LD purpose.

SECTION-VII
INFORMATION TO BE FURNISHED ALONG WITH OFFER

Bidder must ensure the below mentioned documents are to be furnished along with the offer

S.NO	DESCRIPTION
1	Guaranteed Technical Particulars / Data sheet & QAP (for Information Only)
2	Duly signed and stamped copy of Unpriced format mentioning the prices are " **Quoted**"
3	Duly Signed and stamped copy of " Deviation Sheet " by mentioning " **NO DEVIATION** " in the Technical Column
4	Signed and stamped copy of complete enquiry specifications (From Sheet No. 01 to 12).
5	Valid Type test reports shall be submitted along with the offer (Clause No.5.2 & 5.3 of Section –V (Enquiry Specs.))strictly followed by the vendor without affecting the Delivery Schedule. ***Deviation is not acceptable to BHEL*****)**.

ANNEXURE-I

UNPRICE FORMAT

Indent Ref No : IS-1-19-2001/004 dated 07.04.2021

Item Name : 1100V LT VFD POWER CABLES

Project Name-01 : SINGRAULI STPP STAGE-I & II (5X200MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE

Project Name-02 : VINDHYACHAL STPP STAGE-I & II (6X210MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE

Sl No.	Item Description	Type of cable	Unit	Qty	Unit Price (Rs.)	Total Ex Works Price (Rs.)
				(a)	(b)	(c = a x b)
	SINGRAULI TPS					
A)	**VFD POWER CABLE**					
1	(3C x 6 +3 X 6/3) sqmm CU Cable	Power cables shall have mutli- stranded,copper conductors, XLPE insulated, metallic screened, PVC innersheathed,armoured, PVC outer sheathed, round and symmetrical with three symmetrically positioned insulated grounding conductors. The metallic screen of each core shall consist of copper wires or tape with minimum overlap of 20%.	Mtr	1500		
	VINDHYACHAL TPS					
B)	**VFD POWER CABLE**					
1	(3C x 6 +3 X 6/3) sqmm CU Cable	Power cables shall have mutli- stranded,copper conductors, XLPE insulated, metallic screened, PVC innersheathed,armoured, PVC outer sheathed, round and symmetrical with three symmetrically positioned insulated grounding conductors. The metallic screen of each core shall consist of copper wires or tape with minimum overlap of 20%.	Mtr	2000		
		TOTAL (A+B) =				

Note: All the applicable GST, taxes and duties applicable on above shall be indicated seperately.

ANNEXURE-II

TECHNICAL PARTICULARS OF VFD POWER CABLES

Indent Ref No : IS-1-19-2001/004 dated 07.04.2021

Item Name : 1100V LT VFD POWER CABLES

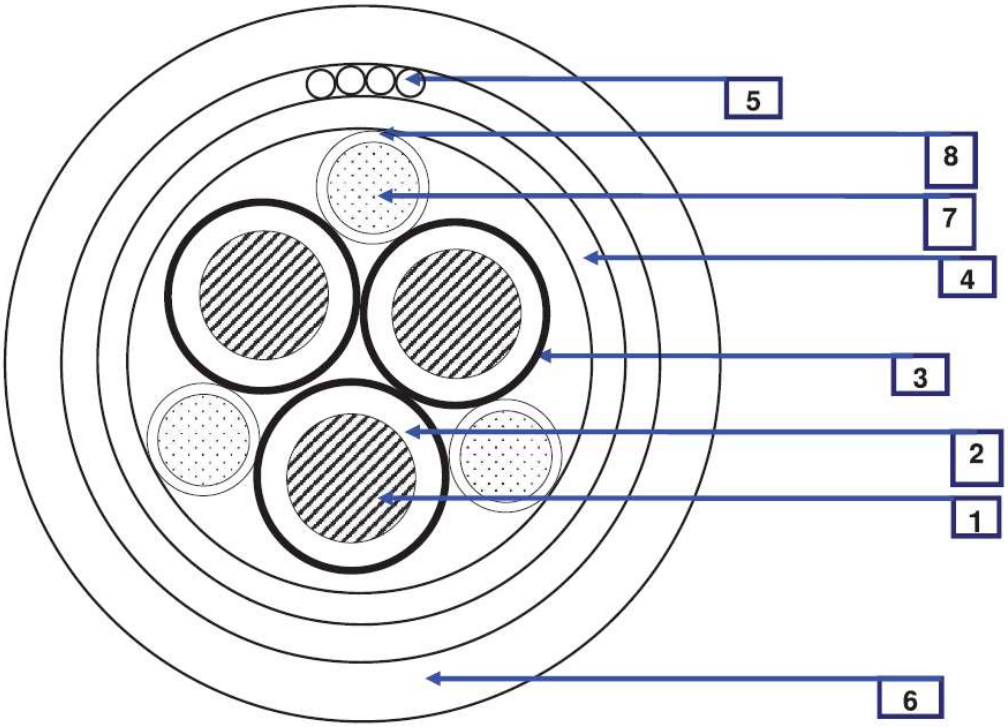
Project Name-01 : SINGRAULI STPP STAGE-I & II (5X200MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE

Project Name-02 : VINDHYACHAL STPP STAGE-I & II (6X210MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE

S.No	Description	Specification
1	Type of Cable	LT XLPE Power Cable for VFD operated Motors
2	Cable size (No. of cores x mm2)	(3C X 6 mm2 + 3 X 6 / 3 mm2) Cu
3	Voltage rating	1.1 kV
4	**Conductor**	
	Material	Annealed bare Copper conductor (Class-2)
	Shape of conductor	Stranded circular
5	**Insulation**	
	Material & type of insulation	Extruded XLPE as per table-1 of IS:7098 (Part-1)
	Nominal thickness of insulation	0.7 mm (minimum)
	Type of Curing	Steam Curing
	Identification of cores	For 3 Cores RED, YELLOW and BLUE Colour
6	**Metallic Screen**	
	Material	Copper Tape
	Size of Tape	(Shall be 20% overlap on each core)
	No. of tapes	Three Tape (one for each core)
7	**Inner Sheath**	
	Material and Type	Extruded FRLS PVC Type-ST2 as IS-5831
	Colour of Outer Sheath	Black
8	**Armour**	
	Material and Type of Armour	Single Layer of Galvanised Steel

	Shape	Round Wire
9	**Outer Sheath**	
	Material and Type	Extruded FRLS PVC Type-ST2 as IS-5831 & IS-7098 (Part-I)
	Colour of Outer Sheath	Black
9	**Grounding Conductor Information**	
9.1	**Conductor**	
	Conductor Material	Annealed Bare Copper Conductor as per Class-2 of IS:8130
	Grade	Electrolytic
	Nominal Cross Sectional Area (No. of core X Area)	3 X 6 /3 (each core of 2 sq.mm)
	Shape of Conductor	Stranded Circular
9.2	I**nsulation**	
	Material & type of insulation	Extruded XLPE as per table-1 of IS:7098 (Part-1)
	Nominal thickness of insulation	0.7 mm (minimum)
	Colour Code of Ground Wire	Green
10	**Marking**	
	Sequential Marking on Outer Sheath	Print / Embossing on Outer sheath on every one Meter
	Embossing on outer sheath	" SUPPLIER NAME – YEAR OF MANUFACTURING – CABLE SIZE -1100V -FRLS
11	**Cable Drum**	
	Cable Drum type (Wooden / Steel)	Non-returnable
	Standard drum length	1000 Mtrs.+/-5% Tolerance
12	**Performance requirement**	
	Oxygen Index of outer Sheath	29 (minimum) (as per IS : 10810 Part-58)
	Acid gas generation by Weight	20%(maximum) (as per IS-754-1)
	Smoke density rating	60% (**maximum**) (as per ASTM D-2843)
13	Recommended Min.installation radius (mm)	12 X Over all Diameter of cable

Cross Sectional drawing of 3C X 6 + 3C X 6/3 sq.mm Cu VFD Cable



Cable Details :

1. **Conductor :** Stranded Circular Annealed bare Copper Conductor
2. **Insulation :** Extruded XLPE
3. **Metallic Screen :** Single Layer of Plain Copper tape
4. **Inner Sheath :** Extruded PVC Type ST-2
5. **Armour :** Galvanised Steel Round Wire
6. **Outer Sheath :** Extruded PVC Type ST-2
7. **Ground Conductor :** Stranded Circular Annealed bare Copper Conductor
8. **Insulation :** Extruded XLPE

ANNEXURE-III

TECHNICAL DATA SHEET FORMAT

Indent Ref No : IS-1-19-2001/004 dated 07.04.2021

Item Name : 1100V LT VFD POWER CABLES

Project Name-01 : SINGRAULI STPP STAGE-I & II (5X200MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE

Project Name-02 : VINDHYACHAL STPP STAGE-I & II (6X210MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE

S.No	Description	Units	Technical particulars
1	**Manufacturer's name and address**		
2	**Country of Manufacturer**		
3	**Type designation**		
4	**Applicable Standard**		Generally confirming to IS: 7098 (Part-1)
5	**Cable sizes (No. of cores x mm2)**		(3C x 6 + 3 x 6/3)
6	**Rated Voltage**	Volts	1100
7	**Continuous current rating for max. cond. temp. when laid in air at ambient temperature of 50 Deg.C**		
	a) When armour is earthed at one end	Amps	
	b) For unarmoured cables	Amps	Not applicable
8	**Continuous current rating for max. conductor temperature when buried in soil having thermal resistivity of 150 Deg .C cm/N at a depth of 1.0 meter at ground ambient temp.of 40 Deg C**		
	a) When armour is earthed at one end	Amps	
	b) For unarmoured cables	Amps	Not applicable
9	**Short circuit withstand capacity and duration for**		
	a) Conductor (For one second)	kA/sec	
	b) Armour (For one Second)	kA/sec	
10	**Conductor**		
	a) Material		Stranded Copper conductor
	b) Grade		Anneleaed bare (as per IS: 8130)
	c) Nominal cross sectional area	sq.mm	6
	d) Number and diameter of wires before compacting of conductor strands		
	i) No. of Strands	No's	7
	ii) Nominal Diameter of each wire in mm (before stranding)	mm	Diameter shall be suitably selected to meet the DC Resistance of conductor as per IS: 8130
	e) Shape of conductor		Stranded Circular
	f) Diameter over conductor (mm.)		
	i) Fictitious (as per IS: 10462 (Part-1)1983)	mm	
	ii) Approximate	mm	
	g) Direction of lay of stranded layer		Shall be as per IS: 8130

	h) Conductor resistance (DC) at 20 ^{o}C (maximum)	Ohm/km	
11	**Conductor Resistance (AC)**		
	a) At 20 Deg. C (approx)	Ohm/km	
	b) At 90 Deg. C (approx.) (For XLPE Cables)	Ohm/km	
12	**Reactance per phase at 50 Hz (approx.)**	Ohm/km	
13	**Capacitance at 50 Hz (approx.)**	uF/km	
14	**Insulation**		
	a) Material & Type of insulation		Extruded XLPE as per Table-1 of IS: 7098 (Part-1)
	b) Nominal thickness of insulation	mm	0.7*
	c) Tolerance on thickness of insulation	(-ve) mm	The smallest of the measured values of thickness of insulation shall not fall below the nominal value specified by more than 0.1 + 0.1*t (where t= Nominal thickness of insulation)
	d) Filled or unfilled (for XLPE Only)		Extruded
	e) Type of curing (for XLPE Only)		Steam curing
	f) Min. Volume resistivity at		
	i) 27 Deg C	Ohm-cm	
	ii)90 Deg C (for XLPE only)	Ohm-cm	
	g) Identification of cores		For 3 Cores Red, Yellow & Blue colour
15	**Insulation screening (wherever applicable)**		
	a) Material & type		Not applicable
	b) Approx Thickness of extruded layer	mm	Not applicable
16	**Metallic screen**		
	a) Material		Copper tape
	b) Size of tape/wire (Min.)		... mm x ... mm (shall be of 20% overlap on each core)
	c) No. of wire/tapes	No's	three tape (one for each core)
	d) Short Circuit capacity of metallic screen (approx)	kA	
	e) Approx Cross Sectional Area of screen (approx)	mm	
	f) Approx dia below metallic screen	mm	
17	**Inner Sheath**		
	a) Material and Type		Extruded FRLS PVC "Type ST-2" as per IS: 5831
	b) Diameter over the Laidup cores		
	i) Calculated (By fictitious calculations as per IS:10462 (Part-1)-1983)	mm	
	ii) Approximate	mm	
	c) Thicknes of Inner Sheath (minimum)	mm	
	d) Colour of Inner sheath Black		
	e) Tolerance in thickness of inner sheath		Min. thickness 0.3 mm of inner sheath shall be maintained for Cable Size 3C x 6 sq mm.
18	**Material and Type of filler**		PVC filler (if required)
19	**Armour (In case of Armoured cables)**		
	a) Material and Type of armour		Single Layer of Galvanised Steel
	b) Shape		Round Wire
	c)Diameter of the cable over Inner sheath (under armour)		

	i) Calculated (By fictitious calculations as per IS: 10462 (Part-1)-1983)	mm	
	ii) Approximate	mm	
	d) Dimension of ~~Formed wires~~ / wires	mm	
	e) No. of ~~Formed wires~~ /wires (approx)	No's	
	f) Max. Resistivity of armour ~~formed wire~~/ wire at 20 deg. C	Ohm-cm	
	g) Direction and Lay of armour		
	h) Approx Cross Sectional Area of armour	Sq mm	
20	**Outer Sheath**		
	a) Material and Type		Extruded FRLS PVC "Type ST-2" as per IS: 5831 & IS: 7098 (Part-1)
	b) Diameter under the outer sheath		
	i) Calculated (By fictitious calculations as per IS: 10462 (Part-1)-1983)	mm	
	ii) Approximate	mm	
	c) Minimum thickness of Outer sheath	mm	
	d) Colour of Outer Sheath		Black
21	**Guaranteed value of Min. Oxygen Index of outer sheath**		Minimum oxygen Index 29. (as per IS: 10810 Part-58)
22	**Max. Acid gas generation by weight**		20% (max) (as per IEC-754-1)
23	**Max. Smoke Density rating (% age)**		60% (max.) (as per ASTM D-2843)
24	a) Overall diameter of cable (approx)	mm	
	b) Tolerance on overall diameter	mm	
25	**Recomended min. installation radius (mm.)**	mm	12 x Overall diameter of cable
26	**Max. Safe Pulling force when pulled by pulling eye on**	N	
27	**Cable Drums**		
	a) Type (wooden/Steel)		Non - returnable wooden drums as per IS: 10418
	b.) Dimensions * (approx) for 1000 meters Length		
	I) Flange diameter	mm	As per IS: 10418
	ii) Barrel diameter	mm	As per IS: 10418
	iii) Traverse	mm	As per IS: 10418
28	**Max//Standard length per drum for each size of cable**	meters	1000 mtrs with ± 5% tolerance
29	**No technical deviation w.r.t to NTPC Specification**		
30	**All Technical Specification of cables are applicable**		
31	**Embossing on Outer Sheath**		" Manufacturer Name - Year of Manufacturing - Cable size - 1100 V - FRLS" shall be embossed at every two meter
32	**Sequential marking on Outer Sheath**		Printed / Embossing on the outer sheath at every one metre
33 Grounding Conductor information :			
33.1	**Conductor**		
	a) Material		Annealed Bare Copper Conductor as per Class-2 of IS: 8130
	b) Grade		Electrolytic Grade
	c) Nominal cross sectional area (No. of Core x Area)	sq.mm	3 x 6/3 (each core of 2 Sq mm.)

	d) Number and diameter of wires before compacting of conductor strands		
	i) No. of Strands	No's	7
	ii) Nominal Diameter of each wire in mm (before stranding)	mm	Diameter shall be suitably selected to meet the DC Resistance of conductor as per IS: 8130
	e) Shape of conductor		Stranded Circular
	f) Diameter over conductor (mm.)		
	i) Fictitious (as per IS: 10462 (Part-1)1983)	mm	
	ii) Approximate	mm	
	g) Direction of lay of stranded layer		Shall be as per IS: 8130
	h) Conductor resistance (DC) at 20 ^{o}C (maximum)	Ohm/km	
33.2	**Insulation**		
	a) Material & Type of insulation		Extruded XLPE as per Table-1 of IS: 7098 (Part-1)
	b) Nominal thickness of insulation	mm	0.7*
	c) Tolerance on thickness of insulation	(-ve) mm	The smallest of the measured values of thickness of insulation shall not fall below the nominal value specified by more than 0.1 + 0.1*t (where t= Nominal thickness of insulation)
	g) Identification of cores		Green
Note*-Here insulation thickness shall be suitably increase to fix the Ground Conductor in the interstices of Phase Core & also to make cable circular in shape)			
NOTE : Wherever required suitable binder(s) & filler(s) shall be used.			

ANNEXURE-IV
MQP TO BE FOLLOWED BY BIDDER

Indent Ref No : IS-1-19-2001/004 DATED 07.04.2021

Item Name : 1100V LT VFD POWER CABLES

Project Name-01 : SINGRAULI STPP STAGE-I & II (5X200MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE
Project Name-02 : VINDHYACHAL STPP STAGE-I & II (6X210MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE
Note : This approved QAP is applicable for Aluminum Cable. Bidder has to submit the QAP applicable for Copper Cable in line with this NTPC approved QAP during approval stage.

NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE-S-041 REV-01 DATE : 29/11/2018 Page 1 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA 28.11.18

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D *	M	C	N	
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 cable drum. 2) Cable manufacturer to maintain all quality control records identified as per all QP stages enumerated below whether it is identified for NTPC verification or witness or not.														
A	**Raw material/ Brought out Items**													
1.01	Aluminum	1.Make	MA	Verify	100%	--	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	QCR		V	--	--	
		2. Resistivity	MA	Elect	As per Cable Mnfr Std.	--	IS5082	IS5082	-do--		P	--	--	
1.02	PVC / XLPE/compound for insulation	1. Make	MA	Verify	--do--	100%	MANUFACTURER APPROVED SOURCES	MANUFACTURER APPROVED SOURCES	--do--		V	V	--	
		2. Type/ Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	--do--		V	V	V	
		3. All acceptance test as per manufacturer norms including thermal stability test for PVC insulation	MA	Verify	As per manufacturer norms	As per manufacturer norms	NTPC ADS	NTPC ADS	--do--		V	V	V	Refer note 1
1.03	PVC Compound for Inner sheath	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V	
		2. Type/ Grade	MA	Verify	--do--	--do--	NTPC ADS	NTPC ADS	--do--		V	V	V	
1.04	Steel wire / Formed Wire (As applicable)	1. Make	MA	Verify	--do--	--do--	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	--do--		V	V	V	
		2. Dimension	MA	Meas	1 sample from each size / lot	--	NTPC APPROVED DATA SHEET & IS 3975	NTPC APPROVED DATA SHEET & IS 3975	--do--		P	--	--	
		3. All acceptance tests as per IS 3975	MA	Verify	As per IS 3975	--	IS 3975	IS 3975	Supplier TC		V	V	--	
1.05	PVC compound for Sheath	1. Make	MA	Verfy	As per manufacturer norms	100%	MANUFACTURER APPROVED sources	MANUFACTURER APPROVED sources	QCR		V	V	--	
		2. Type / Grade	MA	Verify	100%	100%	NTPC ADS	NTPC ADS	QCR		V	V	V	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 2 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		3. All acceptance test as per manufacturer norms	MA	Verify	As per manufacturer norms	As per manufacturer norms	NTPC ADS	NTPC ADS	QCR		V	V	V	Refer note 1
		4. Thermal Stability	MA	Chem	One sample / Batch	--	NTPC ADS	NTPC ADS	QCR		P	--	--	
		5. Oxygen Index	MA	Chem	--do--	--	NTPC ADS/ IS 10810 Part 58	NTPC ADS/ IS 10810 Part 58	--do--		P	---	--	
		6. Acid Gas Emission	MA	Chem	One sample / Batch	--	NTPC ADS / IEC60754	NTPC ADS / IEC60754	QCR		P	--	--	
1.06	Wooden Drum	1. Dimension	MI	Meas	Manuf. Std.	--	IS 10418	IS10418	--do--		P	--	--	
		2. Anti termite treatment	MI	Chem	Cable manuf. std	--	CABLE MANUF. STD.	CABLE MANUF. STD.	COC		V	V	V	COC from drum manuf.
1.07	Steel Drum	1. Dimension	MI	Meas	--do--	--	--do--	--do--	QCR		P	--	--	
		2. Surface finish	MI	Meas	--do--	--	--do--	--do--	--do-		P	--	--	
B	**Process & Stage Inspection**													
2.01	Wire Drawing	1.Surface finish	MA	Visual	One sample/Setting of each size	--	SHOULD BE SMOOTH & FREE FROM SCRATCHES	SHOULD BE SMOOTH & FREE FROM SCRATCHES	QCR		P	--	--	
		2. Wire Diameter	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		3. Tensile test	CR	Mech	--do--	--do--	--do--	--do--	--do--		P	V	V	Refer Sl. No.3.03(iii)
		4. Wrapping test	CR	Mech	--do--	--do--	--do--	--do--	--do--		P	V	V	--do--
2.02	Bunching / stranding	1. No. of wires	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do-		P	--	--	
		2.Dia of wire	MA	Meas	-do--	--	--do--	--do--	--do--		P	--	--	
		3. Dimension of Conductor	MA	Meas	--do--		--do--	--do--	--do--		P	--	--	
		4.Direction of lay	MA	Visual	--do--	---	--do-	--do--	--do--		P	--	--	
		5.Records of strand breakage / welding during conductor stranding	MA	Verify	--do--	--	IS 8130	IS8130	--do--		P	--	--	
		6.Surface finish	MA	Visual	--do--	-	--do--	--do--	--do--		P	--	--	
		7. DC Resistance	CR	Meas	--do--	-	IS8130/NTPC ADS	IS8130/ NTPC ADS	--do--		P	--	--	
2.03	Insulation extrusion	1. Surface finish	MA	Visual	One sample/Setting of each size	-	NTPC spec	SHOULD BE SMOOTH. NO POROSITY IS PERMITTED.	QCR		P	--	--	XLPE/ PVC compound shall be preferably loaded in to extruder by suction method.

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 3 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		10			11
1		2.Colour of cores	MA	Visual	One sample/Setting of each size	-	NTPC ADS	NTPC ADS	QCR		P	--	--	
		3.Thickness	CR	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Spark Test	CR	Elect	100%	100%	CABLE MANUF. STD.	No FAILURE	--do --		P	V	V	1.Spark test failure record is to be verified. 2.Core repairing not permitted
		5. Hot Set	CR	Mech	One sample/Setting of each size	--	IS 7098- Part I	IS 7098- Part I	--do--		P	--	--	Sample is to be taken from both top & bottom end
2.04	Laying up	1. Core sequence	MA	Visual	--do--	--	IS 1554 (Part I) & IS 7098- Part I	IS 1554 (Part I) & IS 7098- Part I	--do--		P	--	--	
		2. Direction of lay	MA	Visual	--do--	--	-do-	--do--	--do--		P	--	--	
		3. Dia over laid up core	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
2.05	Inner Sheath	1.Colour	MA	Visual	-do--	-	--do--	--do--	--do--		P	--	-- -	
		2. Surface Finish	MA	Visual	100%	-	NTPC SPECIFICATION	FISH EYE, BLOW HOLE NOT PERMITTED	--do--		P	--	-	
		3.Thickness	MA	Meas	One sample/Setting of each size	-	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Dia over inner sheath	MI	Meas	--do--.	-	--do--	---do--	--do--		P	--	--	
2.06	Armouring (As Applicable)	1.Dimension	MA	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		2.No. of wires / strip	MA	Meas.	--do--	-	--do--	--do--	--do--		P	--	--	
		3. Direction of lay	MA	Visual	--do--	--	IS 1554 (Part I) & IS 7098- Part I	IS 1554 (Part I) & IS 7098- Part I	QCR		P	--	--	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 4 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		10			11
		4.Coverage & Quality of armouring	MA	Meas.	100%	--	Min. area of coverage of armouring shall be 90%. The gap between amour wires / formed wires shall not exceed one amour wire/ formed wire space & there shall be no cross over/ over riding of amour wire / formed wire. Zn rich paint shall be applied on amour joint surface of G.S. Wire /formed wire. The breaking load of amour wire joint shall not be less than 95% of that amour wire / formed wire. (As per NTPC specification)		QCR		P	--	--	
		5 Dia over armouring	MA	Meas.	One sample/Setting of each size	--	NTPC ADS		--do--		P	--	--	--
2.07	Outer Sheath	1. Surface finish	MA	Visual	100%	--	Pimple, Fish Eye, Burnt particles, Blow Hole not permitted. Repairing on outer sheath not permitted. (As per NTPC specification)		--do--		P	--	--	PVC FRLS compound shall be preferably loaded in to extruder by suction method.
		2.Colour of sheath	MA	Visual	One sample/Setting of each size	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		3. Dia over outer sheath	MA	Meas	--do--	--	NTPC ADS	NTPC ADS	--do--		P	--	--	
		4.Thickness of outer sheath	CR	Meas	--do--	-	--do--	--do--	--do--		P	--	--	
		5. Embossing quality	MA	Visual	100%	-	Drum No.,IS1554-I & IS7098-1,Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (As per NTPC specification)		--do--		P	--	--	Drum No. on Cable may be embossed/printed
		6. Sequencial marking	MA	Visual	Full length	--	Sequencial marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible. (A s per NTPC specification) In addition, Drum No. is also to be embossed/printed on full cable length		--do--		P	--	--	
C	**Finished Cables**													
3.01	Type test reports clearance from NTPC	All type tests as per NTPC specification	CR	Doc.	100%	100%	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Partl) & IS 7098-Part I	NTPC SPECIFICATION / NTPC ADS / IS 1554 (Partl) & IS	--do--	✓	P	V	V	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

	Engineering														
एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables		STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)				QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 5 of 9	7098- Part I REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR		APPROVED BY K K OJHA				
Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9		10			11
3.02	Routine Tests	1.High Voltage test at room temperature	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certific ate	✓	P	W	V	Refer note 2
		2.Conductor Resistance	CR	Elect	100%	100%	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	Test certific ate	✓	P	W	V	Refer note 2
3.03	**Acceptance Tests**													
3.03 (i)	Construction of finished Cable	1. OD of Cable	MA	Meas.	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		2. Laying of core	CR	Visual	--do--		NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	NTPC ADS / IS 1554 (Part I) & IS 7098- Part I	--do--	✓	P	W	W	
		3. Core Identification	CR	Visual	--do--		--do--	--do--	--do--	✓	P	W	W	
		4. Colour of outer sheath	MA	Visual	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		NTPC ADS	NTPC ADS	--do--	✓	P	W	W	
		5. Inner sheath thickness	CR	Meas	- do -		--do--	--do--	--do--	✓	P	W	W	
		6. Inner sheath colour	MA	Visual	- do -		- do -	- do -	--do--	✓	P	W	W	
3.03 (ii)	Armour wires/ Formed wires (if applicable)	1.Dimensions	CR	Meas	--do--		NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI) /IS3975	--do--	✓	P	W	W	
		2. No. of wires/ formed wire	CR	Mech	-- do --		--do--	--do--	--do--	✓	P	W	W	
		3. Tensile test	CR	Mech	--do--		--do-	--do--	--do--	✓	P	V	V	
		4. Elongation test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	V	V	
		5.Torsion test (for round wires only)	CR	Mech	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		--do--	--do--	--do--	✓	P	V	V	
		6. Wrapping test	CR	Mech	--do--		--do--	--do--	--do--	✓	P	V	V	
		7. Resistance test	CR	Mech	--do--		--do--	--do-	--do-	✓	P	V	V	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 6 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		8.Mass of Zinc coating	CR	Meas	--do--		--do--	--do--	--do--	✓	P	V	V	
		9. Uniformity of Zinc Coating	CR	Chem.	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098-Part I		NTPC ADS /IS1554(PartI)/IS3975	NTPC ADS /IS1554(PartI) /IS3975	Test certific ate	✓	P	V	V	
		10.Adhesion test	CR	Mech	--do--		--do--	--do-	--do--	✓	P	V	V	
		11.Freedom from defects	CR	Visual	--do--		--do--	--do--	--do--	✓	P	V	V	
3.03 (iii)	Conductor													
		1.Resistance Test	CR	Elect	--do--		--do--	--do--	--do--	✓	P	W	W	
		2.Tensile test (For aluminum conductor only)	CR	Mech	Each type & size of cables as per sampling plan of IS IS 1554 (Part I)/7098(Part-I)		NTPC ADS/ IS 8130	NTPC ADS/ IS 8130	--do--	✓	P	W	W	Test report of manufacturer to be reviewed as per Sl. No. 2.01 for Tensile test & wrapping test (for Aluminum) in case this test is not applicable for cable under inspection as per IS 8130 cl. 6.2
		3.Wrapping test (For aluminum conductor only)	CR	Mech	--do--		--do--	--do--	-do--	√	P	P	W	--do--
3.03 (iv)	PVC / XLPE Insulation & PVC Sheath	1.Thickness of insulation & sheath	CR	Meas.	--do-		NTPC ADS/ IS 1554(PartI) & IS 7098-Part I	NTPC ADS/ IS 1554(PartI) & IS 7098-Part I	--do--	✓	P	W	W	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"
FORMAT NO:QS-01-QAI-P-10/F3-R1

एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 7 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		2.Tensile strength & elongation at break of insulation & outer sheath	CR	Mech	Each type & size of cables as per sampling plan of IS IS 1554 (Part 1)/IS7098(Part-1)		NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	Test Certific ate	✓	P	W	W	
		3.Tensile strength & elongation of PVC at break of insulation & outer sheath (Ageing Test)	CR	Mech	One sample per batch of offered lot irrespective of sizes		--do--	--do--	--do--	✓	P	V	V	MTR for Ageing Test of the offered lot shall be verified
		3a. Tensile strength & elongation of XLPE at break of insulation (Ageing Test)	CR	Mech	--do--		NTPC ADS/ IS 7098 Part I	NTPC ADS/ IS 7098 Part I	--do--	√	P	V	V	MTR for Ageing Test of the offered lot shall be verified
		4. Insulation resistance (Volume resistivity method)	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		--do--	NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	--do--	✓	P	W	W	
		5.High voltage test at room temperature	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		--do--	--do--	--do--	✓	P	W	W	
		6.Thermal stability on PVC Insulation and outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		-do--	--do--	--do--	✓	P	W	W	
		7. Hot Set Test (for XLPE Insulation only)	CR	Elect	Each type & size of cables as per sampling plan of IS 1554 (Part 1) & IS 7098- Part I		NTPC ADS/ IS 1554(PartI) & IS 7098 Part I	--do--	--do--	✓	P	W	W	
		8.Oxygen index Test on outer sheath	CR	Chem	One sample of each offered lot of all offered sizes		NTPC ADS / IS10810 Part 58	NTPC A.D.S / IS10810 Part 58	Test certific ate	✓	P	W	W	Refer Note 3

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 8 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/ N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11
		9.Smoke density rating test on outer sheath	CR	Chem	--do--		NTPC ADS & ASTMD2843	NTPC ADS	-do--	✓	P	W	W	Refer Note 3
		10.Acid gas generation test on outer sheath	CR	Chem	--do--		NTPC ADS & IEC 60754-1	'NTPC ADS	Test Certific ate	✓	P	W	W	Refer Note 3
		11.Flammability test on completed cable	CR	Chem	Refer Note 4	Refer Note 4	NTPC ADS & IEC 60332 Part-3 (Category-B)	NTPC ADS	--do--	✓	P	W	W	
		12.Surface finish & length measurement.	CR	Visual & Meas	100% (COC from Manufacturer to be submitted for surface finish as per specification's requirement)	one length of each offered lot of 50 drums of all sizes	(1) IS1554-I & IS7098-1, Cable size, Voltage grade & Words "FRLS" at every 5 meter is to be embossed. Embossing shall be automatic, in line & marking shall be legible & indelible. (2) Sequential marking of length of cable in meter at every one meter is to be embossed / printed. Embossing / printing shall be progressive, automatic, in line & marking shall be legible & indelible		--do--	✓	P	W	W	Pimple, Fish Eye, Burnt particles, Blow Hole etc. not permitted. Repairing on outer sheath not permitted.
		13. Sequence of cores armour coverage, gap between two consecutive armour/ formed wire	CR	Visual & Meas	One length of each size	One length of each size	Min. area of coverage of armouring shall be 90%. The gap between armour wires / formed wires shall not exceed one armour wire/ formed wire space & there shall be no cross over/ over riding of armour wire / formed wire. Zn rich paint shall be applied on armour joint surface of G.S. Wire /formed wire		--do-	√	P	W	W	
4	Packing	1. Sealing	MA	Visual	100%	100%	(1)IS1554(Part-I) & IS 7098-Part I (2) The surface of the drum and the outer most cable layer shall be covered with water proof cover. (3) Both the ends of cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by "U" nails.		QCR	✓	P	--	--	
4.01	Identification	NTPC Sealing	MA	Visual	100%	100%	Sealing shall be visible		QCR	√	P	V	V	

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

एनटीपीसी NTPC	Item: 1.1 KV Power (XLPE & PVC) Insulated FRLS cables	STANDARD QUALITY PLAN (CONFORMING TO CODE: IS 1554 PART 1 , IS 7098 Part-I AND NTPC TECHNICAL SPECIFICATION)	QP. NO. 0000-999- QOE- S-041 REV-01 DATE : Page 9 of 9	REVIEWED BY AMAN PANDEY RAJESH SHARMA S K LAL DINESH KUMAR	APPROVED BY K K OJHA Approved Dt.

Sl. No	Component & Operations	Characteristics	Class	Type of check	Quantum of check		Reference Document	Acceptance Norms	Record Format	Agency				Remarks
					M	C/N				D*	M	C	N	
1	2	3	4	5	6		7	8	9	10				11

Notes:

1)	If the compound manufacturer is carrying out Ageing test, test report of compound manufacturer is to be reviewed. If the compound manufacturer is not carrying out ageing test, then cable manufacturer is to carry out ageing test & test report is to be reviewed (quantum of ageing test sample shall be one sample /batch)
2)	2(a) **In case of manufacturers / supplier who have supplied cables in the past through Corporate Centre**:- Routine Test of manufacturer internal test report are to be verified by NTPC at the time of final inspection. 2(b) **In case of manufacturers / supplier WHO HAVE NOT SUPPLIED cables in the past through Corporate Centre**:- Routine Test are to be witnessed by Main Contractor on 100% basis. This is in addition to manufacturer internal test report to be verified by NTPC at the time of final inspection. Same is to be verified by NTPC
3)	1. For Smoke Density rating test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection. 2. For Acid Gas Generation test: if the test result without conditioning is within (-)10% of the maximum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection. 3. For Oxygen Index test: if the test result without conditioning is within (+)7% of the minimum specified value, then, retesting is to be carried out with conditioning of samples as per standard and the test results after conditioning shall be final for acceptance/rejection. 4. In case the test results without conditioning donot meet the maximum/minimum specified value, the manufacturer may exercise the option of retesting the samples after conditioning as per standard.
4)	For PVC insulated LT power cable :- For cables with OD less than equal to 30 mm, any size of cable may be clubbed together. For cables where OD is more than 30 mm, clubbing to be done for cables having similar ODs. For XLPE insulated LT Power cable: Clubbing to be done for cables having similar ODs.
LEGEND:	**NTPC ADS: NTPC approved data sheet, QCR: quality control records of cable manufacturer, CABLE MANUF STD- cable manufacturer's internal plant standard, MI: minor, MA: major, CR: critical, COC- certificate of conformance**

LEGEND:- *RECORDS, IDENTIFIED WITH "TICK" UNDER COLUMN "D" SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
-M:MANUFACTURER/SUPPLIER, C:MAIN SUPPLIER, N:NTPC, P:PERFORM W:WITNESS,V:VERFICATION AS APPROPRIATE, CHP: NTPC SHALL IDENTIFY IN COLUMN "N" AS "W"

ANNEXURE-V
NTPC SPECIFICATIONS FOR LT POWER CABLES

Indent Ref No : IS-1-19-2001/004 DATED 07.04.2021

Item Name : 1100V LT VFD POWER CABLES

Project Name-01 : SINGRAULI STPP STAGE-I & II (5X200MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE
Project Name-02 : VINDHYACHAL STPP STAGE-I & II (6X210MW+2X500MW) RENOVATION & RETROFITTING OF ESP PACKAGE

SUB-SECTION-III-E-3

LT POWER CABLES

000318

1.00.00 **CODES & STANDARDS**

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS : codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS :1554 - I	PVC insulated (heavy duty) electric cables for working voltages upto and including 1100V.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages upto and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
IEC-754 (Part-I)	Tests on gases evolved during combustion of electric cables.
IEC-332	Tests on electric cables under fire conditions. Part-3: Tests on bunched wires or cables (Category-B).

000319

2.00.00 TECHNICAL REQUIREMENTS

2.01.00 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.02.00 All cables including EPR cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses developed under steady state and transient operating conditions as specified elsewhere in this specification.

2.03.00 Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be stranded.

2.04.00 XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250 deg C. PVC insulation shall be suitable for continuous conductor temperature of 70 deg C and short circuit conductor temperature of 160 deg. C.

2.05.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS : 5831.

2.06.00 For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables, armouring shall be of galvanised steel as follows :

Calculated nominal dia. of cable under armour	Size and Type of armour
Upto 13 mm	1.4mm dia GS wire
Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire
Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

2.06.01 The aluminium used for armouring shall be of H4 grade as per IS: 8130 with maximum resistivity of 0.028264 ohm mm^2 per meter at 20 deg C. The sizes of aluminium armouring shall be same as indicated above for galvanized steel.

2.06.02 The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire.

2.07.00	Outer sheath shall be of PVC as per IS: 5831 & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties. (a.) Oxygen index of min. 29 (as per IS 10810 Part-58). (b.) Acid gas emission of max. 20% (as per IEC-754-I). (c.) Smoke density rating shall not be more than 60 % (as per ASTMD-2843).
2.08.00	Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted: 1 core - Red, Black, Yellow or Blue 2 core - Red & Black 3 core - Red, Yellow & Blue 4 core - Red, Yellow, Blue and Black
2.09.00	For reduced neutral conductors, the core shall be black.
2.10.00	In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath. (a.) Cable size and voltage grade - To be embossed (b.) Word 'FRLS' at every 5 metre - To be embossed (c.) Sequential marking of length of the cable in metres at every one metre -To be embossed / printed The embossing shall be progressive, automatic, in line and marking shall be legible and indelible. For EPR cables identification shall be printed on outer sheath.
2.11.00	All cables shall meet the fire resistance requirement as per Category-B of IEC 332 Part-3.
2.12.00	Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum, over the declared value in the technical data sheets.
2.13.00	In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.
2.14.00	Cable selection & sizing
2.14.01	Cables shall be sized based on the following considerations: (a) Rated current of the equipment (b) The voltage drop in the cable, during motor starting condition, shall be limited to 10% and during full load running condition, shall be limited to 3% of the rated voltage

000321

(c) Short circuit withstand capability

This will depend on the feeder type. For a fuse protected circuit, cable should be sized to withstand the letout energy of the fuse. For breaker controlled feeder, cable shall be capable of withstanding the system fault current level for total breaker tripping time inclusive of relay pickup time.

2.14.02 Derating Factors

Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:

a) Variation in ambient temperature for cables laid in air

b) Grouping of cables

c) Variation in ground temperature and soil resistivity for buried cables.

2.14.03 Cable lengths shall be considered in such a way that straight through cable joints are avoided.

2.14.04 Cables shall be armoured type if laid in switchyard area, CHP area or directly buried.

2.14.05 All LT power cables of sizes more than 120 sq.mm. shall be XLPE insulated and preferable sizes are 1Cx150, 1Cx300, 1Cx630, 3Cx150 & 3Cx240 sq.mm.

3.00.00 **CONSTRUCTIONAL FEATURES**

3.01.00 1.1 KV Grade Power Cables

(a) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor, XLPE insulated, PVC inner-sheathed (as applicable), armoured/ unarmoured, PVC outer-sheathed conforming to IS:7098. (Part-I).

(b) 1.1KV grade PVC power cables shall have aluminium conductor(compacted type for sizes above 10 sq.mm), PVC Insulated, PVC inner sheathed (as applicable) armoured/ unarmoured, PVC outer-sheathed conforming to IS:1554 (Part-I).

(c) 1.1 KV grade Trailing cables shall have tinned copper(class 5)conductor, insulated with heat resistant elastomeric compound based on Ethylene Propyline Rubber(EPR) suitable for withstanding 90 deg.C continuous conductor temperature and 250deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968.

4.00.00 CABLE DRUMS

(a) Cables shall be supplied in non returnable wooden or steel drums of heavy construction. 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. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

(b) Each drum shall carry manufacturer's name, purchaser's name, address and contract number, item number and type, size and length of cable and net gross weight stencilled on both sides of the drum. A tag containing 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.

000322

(c) The standard drum length for power cables shall not be less than 500 meters. The length per drum shall be subjected to a maximum tolerance of +/- 5% of the standard drum length. The Employer shall have the option of rejecting cable drum with shorter lengths. For each size, the variance of total quantity, adding all the supplied drum lengths, from the ordered quantity, shall not exceed +/- 2%.

5.00.00 TESTS

1.0 All equipments to be supplied shall be of type tested design. During detailed engineering, the contractor shall submit for Owner's approval the reports of all the type tests as listed in this specification and carried out within last ten years from the date of bid opening. These reports should be for the test conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been either conducted at an independent laboratory or should have been witnessed by a client.

2.0 However if the contractor is not able to submit report of the type test(s) conducted within last ten years from the date of bid opening, or in the case of type test report(s) are not found to be meeting the specification requirements, the contractor shall conduct all such tests under this contract at no additional cost to the owner either at third party lab or in presence of client /owners representative and submit the reports for approval.

3.0 All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price.

4.0 The type test reports once approved for any projects shall be treated as reference . For subsequent projects of NTPC, an endorsement sheet will be furnished by the manufacturer confirming similarity and "No design Change". Minor changes if any shall be highlighted on the endorsement sheet.

5.01.00 **Type Tests**

5.01.01 The reports for the following type tests shall be submitted for one size each of LT XLPE and LT PVC Power cables. Size shall be decided by the employer during detailed engineering:

S.No.	Type test	Remarks
	For Conductor	
1.	Resistance test	
2.	Tensile test	For circular non-compacted conductors only
3.	Wrapping test	For circular non-compacted only
	For Armour Wires/ Formed Wires	

000323

	4.	Measurement of Dimensions	
	5.	Tensile Test	
	6.	Elongation test	
	7.	Torsion test	For round wires only
	8.	Wrapping test	For aluminium wires / formed wires only.
	9.	Resistance test	
	10(a)	Mass of zinc coating test	For GS Formed wires/wires only
	10(b)	Uniformity of zinc coating	For GS Formed wires /wires only
	11.	Adhesion test	For GS Formed wires/wires only
		For PVC/XLPE insulation & PVC Sheath	
	12.	Test for thickness	
	13.	Tensile strength & elongation tests	before ageing and after ageing
	14.	Ageing in air oven	
	15.	Loss of mass test	For PVC insulation and sheath only
	16.	Hot deformation test	For PVC insulation and sheath only
	17.	Heat shock test	For PVC insulation and sheath only
	18.	Shrinkage test	
	19.	Thermal stability test	For PVC insulation and sheath only
	20.	Hot set test	For XLPE insulation only
	21.	Water absorption test	For XLPE insulation only
	22.	Oxygen index test	For outer sheath only
	23.	Smoke density test	For outer sheath only

000324

24.	Acid gas generation test	For outer sheath only
	For completed cables	
25.	Insulation resistance test	
	(Volume resistivity method)	
26.	High voltage test	
27.	Flammability test as per IEC-332 Part-3 (Category-B)	

Indicative list of tests/checks, Routine and Acceptance tests shall be as per Quality Assurance & Inspection table of LT power cables enclosed.

000325