

3 X 800 MW PATRATU STPS EXPANSION PH-I

TECHNICAL SPECIFICATION

FOR

SCREENED CONTROL CABLE

SPECIFICATION NO.: *PE - TS - 434 - 507 - E004*

REVISION : 0



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



DOCUMENT TITLE
3X800MW PATRATU TPS
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES

SPECIFICATION NO. PE-TS-434-507-E004

VOLUME II

SECTION -

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DATE: 23.04.2019

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SPECIFIC TECHNICAL REQUIREMENTS



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COMPLIANCE CERTIFICATE

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

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same
2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in BOQ-Cum-Price schedule of the specification shall not be considered (i.e., technical description & quantities as per specification shall prevail).

BIDDER'S STAMP & SIGNATURE



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1.0 SCOPE

- 1.1 Design, Manufacture, Inspection and testing at manufacture's works, proper packing and delivery to site of **Screened Control cables** conforming to this specification.
- 1.2 General technical requirements of the Screened Control cables are indicated in Section-II. Project specific technical/ quality requirements / changes are listed in Section-I.
- 1.3 The stipulations of Section-I, followed by those of Data Sheet-A shall prevail in case of any conflict between the stipulations of Section-I, Data Sheet - A & Section-II.
- 1.4 The documents shall be in English Language and MKS system of units.

2.0 BILL OF QUANTITIES:

- 2.1 Quantity requirements shall be as per BOQ-cum-price schedule enclosed in NIT.

3.0 SPECIFIC TECHNICAL REQUIREMENTS

<u>S.No.</u>	<u>Reference Clause No. of Section- II</u>	<u>Specific Requirement/ Change</u>
1	3.1	The standard quality plan no. shall be read as 0000-999-QOI-S-035 in place of PE-QP-999-507-E004.
1	3.3	Shall be read as "Type test report requirements, routine / acceptance testing and special testing requirements shall be as per Annexure – C of QP. 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.
2	3.4	This clause is null & void.
3	3.7 (clause is added)	All equipment to be supplied shall be of type tested design. During detailed engineering, the successful bidder shall submit for BHEL/NTPC 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 (17.07.2017). 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 process plant/refinery/power plant/nuclear plant client or client representatives.
4	3.8 (clause is added)	However, if the successful bidder 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 successful bidder shall conduct all such



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		tests under this contract at no additional cost to the BHEL either at third party lab or in presence of BHEL/NTPC and submit the reports for approval.
5	3.9 (clause is added)	The type test reports (for type tests carried out within last ten years from the date of bid opening (17.07.2017) once approved for any project of NTPC shall be treated as reference. For PATRATU TPS, 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	3.10 (clause is added)	If a cable drum fails in site testing then that drum shall be supplied again by vendor free of cost to BHEL.

4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

Following documents/drawings shall be submitted after placement of order for BHEL customer's approval: -

Sl. No.	Drawings/Document Description	Drawings / Document Number
1.	Technical Data Sheet – Screened control cables	PE-V0-434-507-E141
2.	Cross-sectional Drawings – Screened control cables	PE-V0-434-507-E143
3.	Type Test Reports – Screened control cable	PE-V0-434-507-E144
4.	Steel drum drawing (if applicable)	PE-V0-434-507-E145
5.	Standard Quality Plan - Screened control cables	PE-V0-434-507-E916 (*)

NOTE: (*)

Standard Quality Plan as enclosed in the technical specification is to be appended with cover sheet bearing document number & description as stated above. The signed & stamped copy for the same shall be submitted to BHEL without making any changes in the contents of the document.

	DESIGN CALCULATIONS FOR LV CABLE SELECTION & SIZING	Doc. No. PE-DC-434-507-E002
	NTPC LIMITED	Rev No. 0
	3X800 MW PATRATU STPS	24.04.2019

DATA SHEET-A

CABLE DETAILS OF INSTRUMENTATION CABLES (AS PER VDE)

- 1.0 Voltage grade : 225 V (Peak)
- 2.0 Type of cable : FRLS SCREENED CONTROL CABLES
- 3.0 Standards Applicable :

1	VDE 0815, VDE 0816, VDE 0472	General Construction & tests for cables.
2	VDE 0207, Part-4, Part-5, Part-6	For insulation thickness.
3	SEN-SS-424-1475, IEC-60332 Part-3 Cat-B	Flammability Tests
4	ASTMD-2843, ASTMD-2863, IEC-754 Part-1	FRLS Tests
5	IS-8784	SPECIFICATION FOR THERMOCOUPLE COMPENSATING CABLES
6	IS-10810	METHODS OF TEST FOR CABLES
7	ANSI MC-96.1	Thermocouple cable color codes

4.0 CONDUCTOR

- a) Material : Annealed bare copper
- b) Grade : Electrolytic
- c) Standard applicable : VDE 0815
- d) Min number of strands, Dia : 7, 0.3 mm (nom), 0.5 sq.mm
and cross sectional area
- e) Maximum Conductor loop
resistance/km (in ohm) at 20 : 73.4
degrees celsius
- f) Continuous operation suitability : 70 DEG. C

5.0 INSULATION

	DESIGN CALCULATIONS FOR LV CABLE SELECTION & SIZING	Doc. No. PE-DC-434-507-E002
	NTPC LIMITED	Rev No. 0
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- a) Material : PVC as per VDE 0207 Part 4, compound Y I3
- b) Application : Extruded
- c) Insulation thickness
- Min / Max : 0.25/ 0.35 (for 0.5 sq mm)
- d) Volume resistivity (Min) : 1×10^{14} at 20 deg .C & 1×10^{11} at 70 deg. C in ohm-cm

6.0 LAYING OF CORES

- a) Min. number of twist per Metre for paired cables. : 20 (For 0.5 Sqmm)
- b) Maximum lay of individual twisted pair : 50 mm (For 0.5 Sqmm)
- c) Diameter of core : In accordance with clause 5 (c)

7.0 IDENTIFICATION OF CORES : Band marking

8.0 INDIVIDUALLY SCREENED (F TYPE CABLE)

- a) Material : Aluminium-Mylar tape
- b) Coverage : 100%
- c) Overlap : Minimum 20%
- d) Min thickness (Micron) : 28
- e) Binder : Polyester tape.

9.0 OVERALL SCREENED (G TYPE CABLE)

- a) Material : Aluminium-Mylar tape
- b) Coverage : 100%
- c) Overlap : Minimum 20%
- d) Min. thickness (Micron) : 55

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e) Binder : Polyester tape.

10.0 DRAIN WIRE

To be provided separately for individual pair shield (wherever applicable) and overall shield.

a) Material : Annealed Tin coated copper conductor as per VDE: 0815

b) Min number of strands, Dia : 7, 0.3 mm (nom), 0.5 sq.mm
and cross sectional area

11.0 ACCESSORIES (BEDDING, BINDER, TAPE REQ.)

a) Material : Mylar Tape

12.0 OUTER SHEATH

a) Material : Extruded PVC (compound YM1) as per VDE 0207 Part-5

b) Thickness : As per VDE 0816 and VDE207 Part-5

Minimum Thickness at : 1.8 mm for unarmoured Cable / as per
any point IS-1554-I for armoured cable

Nominal Thickness at : >1.8 mm for unarmoured Cable / as per
any point IS-1554-I for armoured cable

c) Application : Extruded

d) Colour : Blue

e) Whether FRLS : YES

f) Other : Resistant to water, Fungus, Termite &
rodent attack.

g) filler : Non-hygrosopic, flame retardant

13.0 FRLS/ FLAMMABILITY TESTS

a) Oxygen Index : 29% Minimum as per ASTM D 2863

b) Temperature Index : 250 °C Minimum as per ASTM D 2863

c) Acid gas generation : less than 20% by weight (As per IEC-



DESIGN CALCULATIONS FOR LV CABLE SELECTION & SIZING

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- d) Smoke density rating : Not more than 60% (As per ASTM D 2843) Defined as average area under curve when the results of smoke density plotted on a curve indicating light absorption v/s time as ASTM D 2843
- e) Flammability Test : IEEE-383
- f) Swedish Chimney Test : As SEN-SS-424-1475 Class F3,
- 14.0 TOLERANCE ON OVERALL DIAMETER : $\pm 2\text{mm}$ max. over the declared value in Technical Data Sheet
- 15.0 VARIATION IN DIA & OVALITY AT ANY CROSS-SECTION : Maximum 1 mm
Not more than 1mm.
- Cage clam suitability – to be provided

16.0 CABLE DRUM DETAILS

- a) Material Type & Construction: Wooden as per IS 10418 / Steel
- b) Standard drum length : 1000 metres: up to and including 12 Pairs.
500 metres: above 12 pairs
- c) Tolerance on drum length : $\pm 5\%$
- d) Painting : Entire surface to be painted
- e) Outermost Layer : To be covered with waterproof

17.0 RIP CORD : A non-hygroscopic and non-wicking non metallic cord polyethylene.

18.0 Markings on Outer Sheath

- a) Progressive sequential Length marking to be provided : @ 1M by Embossing / Printing
- b) Durable marking @ 625 mm (max.): : Manufacturer's name, type of insulation,

	DESIGN CALCULATIONS FOR LV CABLE SELECTION & SIZING	Doc. No. PE-DC-434-507-E002
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FRLS, conductor size, no. of pairs, voltage grade, type of cable, year of manufacture, Customer name i.e. 'BHEL-PEM' & 'NTPC' shall also be marked @5m.

19.0 TECHNICAL PARAMETERS (C & I) As per Table below

STANDARD CABLE PARAMETERS FOR INSTRUMENTATION CABLE

Parameter	0.5 mm ² (I & OS) type-F	0.5 mm ² (OS) type-G
Mutual Capacitance (max.) at 0.8 kHz, nF/Km	120	100
Conductor Loop Resistance (max.), Ohm/Km	73.4 (Plain)	73.4 (Plain)
Insulation Resistance (min), M Ohm/ Km	100	100
Cross Talk Figure (min) at 0.8kHz, dB	60	60
Characteristic impedance(max.) at 1 kHz	320	340
Attenuation(max.) at 1 kHz db/Km	1.2	1.2

Note:

1. Cable parameters indicated above are at 20 degC (+/- 3 degC)

20.0 TEST VOLTAGE

Core – Core

Core- shield

- a) High voltage test : 2kV RMS for 1 min 0.5kV RMS for 1 min
- b) Resistance to direct current test: 0.22kV DC for 240 hrs/ 10 days

Note : Repaired Cables shall not be acceptable.



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DATA SHEET-C

S.No.	Particulars	Unit	Description
1	Manufacturer's name	-	
2	Reference design standards	-	
3	Conductor size	sq. mm	
4	Rated Voltage	V	
5	Number of pairs	No.	
6	Cable suitable for both earthed & unearthed system	-	
7	Conductor		
	a) Material	-	
	b) Reference Standard	-	
	c) Grade	-	
	d) No. of strands	No.	
	e) Diameter of strands (nom.)	mm	
	f) Approx. dia of conductor	mm	
	g) Cross Section area	sq. mm	
	h) Maximum conductor resistance per Km at 20°C	ohm	
8	Insulation		
	a) Reference Standard	-	
	b) Material composition	-	
	c) Application	-	
	d) Minimum thickness	mm	
	e) Nom.Thickness	mm	
	f) Max. thickness	mm	
	g) Minimum volume resistivity as per IS 5831	Ohm cm	
	h) Dielectric constant	-	
	i) Maximum conductor temperature withstand capacity	°C	
	j) Core diameter including insulation	mm	
9	Core laying		
	a) Whether cores are twisted.	-	
	b) Maximum lay of twist	mm	
	c) Identification of cores	-	
10	Individual Shield		
	a) Material	-	



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	b) Thickness of tape	micron	
	c) Coverage/ Overlap	%	
	d) Noise interference better than	dB	
11	Drain wire for individual shield		
	a) Reference standard	-	
	b) Size (No. of strands/ dia. of each strand)	sq. mm (no./mm)	
	c) Material	-	
	d) Resistance of drain wire per km at 20 deg.C	ohm	
12	Overall shield		
	a) Material	-	
	b) Thickness of tape	mm	
	c) Coverage/Overlap	%	
	d) Noise interference better than	dB	
13	Drain wire for overall shield		
	a) Reference standard	-	
	b) Size/ No.of strands	sq. mm/ no.	
	c) Material	-	
	d) Resistance per Km (with shield) at 20°C	Ohm/ km	
14	a) Fillers: Material (if applicable)		
	b) Bedding Material		
15	Inner sheath		
	a) Material, type and standard	-	
	b) Whether FRLS	-	
	c) Colour	-	
	d) Method of application	-	
	e) Thickness (min)	mm	
16	Armour		
	a) Material,	-	
	b) Formed wire / round wire		
	c) Minimum Coverage	%	
	d) Method of jointing	-	
	e) Breaking load of joint	-	
	f) Size (approx.)	mm	
	g) Dia of armour	mm	
	h) No. of wires	mm	
17	Outer sheath		
	a) Reference standard	-	
	b) Material	-	
	c) Minimum thickness of sheath	mm	
	d) Calculated dia under outersheath	mm	



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	e) Oxygen index (as per ASTM D 2863)	-	
	f) Temperature index (in deg. C as per ASTM D 2863)	-	
	g) Maximum acid gas generation as per IEC754-1	%	
	h) Maximum smoke density rating as per ASTM D 2843	%	
	i) Colour of outer sheath	-	
18	Dia over laid-up core	mm	
19	Dia under armour	mm	
20	Dia above armour	mm	
21	Overall diameter of cable	mm	
22	Tolerance on overall diameter	mm	
23	Weight of		
	Copper (conductor & drain wire)	MT. / km	
	PVC (insulation, sheath & fillers)	MT. / km	
	Armour	MT. / km	
	Cable (approx.)	MT. / km	
24	Cable parameters at 20°C(+/-3 deg. C)		
	a) Conductor resistance (max)	Ohm/ km	
	b) Insulation resistance (min)	M-Ohm	
	c) Mutual capacitance at 0.8KHz (max)	nF/ km	
	d) Cross talk at 0.8KHz (min)	dB	
	e) Attenuation at 1 KHz (max)	dB/ km	
	f) Characteristic impedance at 1 KHz (max)	Ohm	
25	Continuous operating temp. (deg.C)	deg. C	
26	(a) Relevant IS standard including Part & category for Flame retardance of complete cable	-	
	(b) Relevant IEC standard including Part & category for Flammability of complete cable		
27	Whether complete cable passes Swedish Chimney test as per SEN 4241475 (F3)	-	
28	Identification		
	a) Length of cable marked at every mtr.	-	
	b) FRLS marked at every 5 mtrs	-	
	c) Each core of the pair numbered	-	
	d) Conductor identification details for pairs	-	
	e) Details of cable markings	-	
29	Test voltage		
	a) High voltage test/ Dielectric Strength		
	i) Voltage (KV), Core - Core	kV	
	ii) Duration	min	
	b) High Voltage test		
	i) Voltage (KV), Core - Screen	V	



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	ii) Duration	min	
	c) Resistance to direct current test (applicable for 225 V cable as per VDE)	-	
	Voltage	V	
	Duration	hrs/days	
30	Min bending radius	mm	
31	Ovality at any cross section	mm	
32	Variation of dia through out cable length		
33	Cable cross-sectional drawings for each type of cable furnished		
34	i) Length of single coil in a drum	M	
	ii) Marking on drum	-	
	iii) Seasoned wood drum provided	-	
	iv) Both ends of cable to be sealed with PVC/ Rubber caps to prevent water/ moisture ingress		
	v) Gross weight (approx.)	kg.	
	vi) Net weight (approx.)	kg	
35	Type test procedures as per BHEL Technical Spec. and other relevant standards enclosed.		
36	Anti termite & rodent test		



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SECTION-‘II’

GENERAL TECHNICAL SPECIFICATION



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1.0 TECHNICAL REQUIREMENTS

- 1.1 Technical requirements for SCREENED CONTROL CABLES shall be as indicated in this section, in addition to those specified in Datasheet-A.
- 1.2 It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation at site conditions.

2.0 CODES & STANDARDS

- 2.1 The design, material, construction, manufacture, inspection and testing of Screened control cables shall conform to the latest revision of relevant standards and codes of practices mentioned in Data Sheet - A.
- 2.2 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

3.0 QUALITY ASSURANCE REQUIREMENTS

- 3.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E004) as attached with the specification without any deviations. At contract stage, the successful bidder shall submit the same QP for BHEL/ ultimate customer's approval. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ultimate customer's approval. There shall be no commercial implication to BHEL on account of minor changes in QP during contract stage.
- 3.2 All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved Quality Plan.
- 3.3 Type testing requirements, routine/ acceptance testing and special testing requirements shall be as per Annexure –C to QP. Charges for all these tests for all the equipments & components shall be deemed to be included in the bid price (except UV Radiation & Hydraulic Stability test).
- 3.4 The charges of UV Radiation test & Hydrolytic Stability test (if applicable) shall be reimbursed extra at actual against original money receipt of Govt. Lab. (CPRI/ ERDA etc).
- 3.5 Cost of cables consumed for testing shall be to bidder's account.
- 3.6 Type Test Reports for Tests conducted shall be submitted for BHEL's/ Customer's review/approval.

4.0 Packing

- 4.1 Cables shall be supplied in non-returnable drums. Material of cable drum shall be as specified in Datasheet-A.
- 4.2 In case of wooden drums, all wooden parts shall be manufactured from seasoned wood treated with copper naphthenates/ zinc naphthenates (refer IS: 401). Dimensions of wooden drums shall be as per IS 10418. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. BIS certification mark shall be stamped on each cable drum. Over the cables polyethylene sheet shall be wrapped and then sealed properly.
- 4.3 In case of Steel drums, new or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. For Typical details of Steel drums, Annexure-B to Section-II, may be referred by the bidder. Bidder may modify, to choose appropriate dimensions of steel drums to suite various sizes/weight/ lengths.



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ANNEXURE : A

**CORE IDENTIFICATION / PAIR
IDENTIFICATION**



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ANNEXURE : B-I

The cable cores shall be colour coded as mentioned below:

PAIR	CORE	COLOUR
1 st	1 st	Blue
1 st	2 nd	Red
2 nd	1 st	Grey
2 nd	2 nd	Yellow
3 rd	1 st	Green
3 rd	2 nd	Brown
4 th	1 st	White
4 th	2 nd	Black

Each four pair is laid to form one unit and wound with Mylar tape. The cores of each unit shall then be identified by colour bands for cables of more than 4-pair. eg. All eight cores of the first unit shall have a single band of pink colour (preferably rose pink).

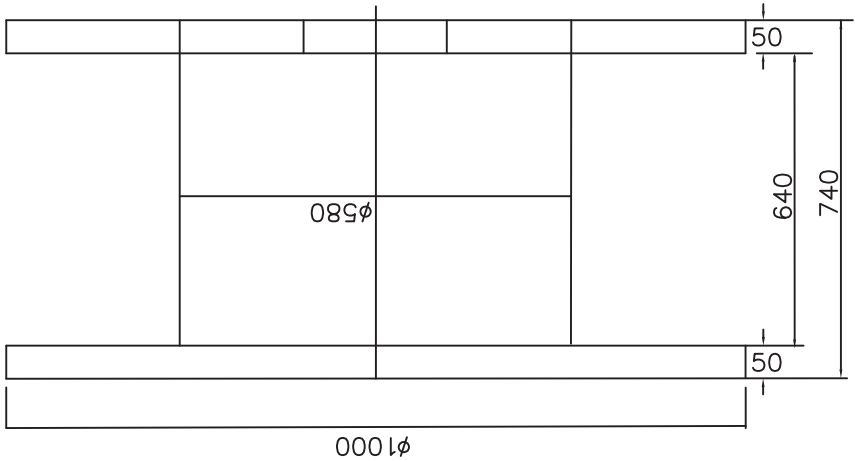
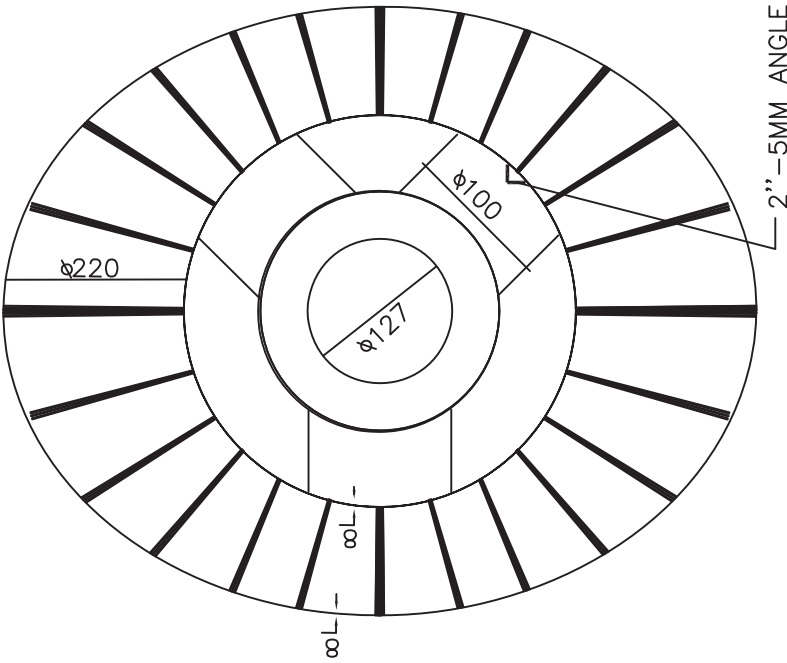
Unit No No.	COLOUR OF BANDS	BAND MARKS
1. 2. 3. 4.	PINK	= === == = ===== == = === == = === ==
5. 6. 7. 8.	ORANGE	= === == = ===== == = === == = === ==
9. 10. 11. 12.	VIOLET	= === == = ===== == = === == = === ==

The dimension L (distance between the marking) shall be limited to 60mm. The bands shall be neat and cover at least 2/3 of the periphery of the core.
eg: A grey wire having 3 orange bands is the first core of the second pair of the seventh unit.

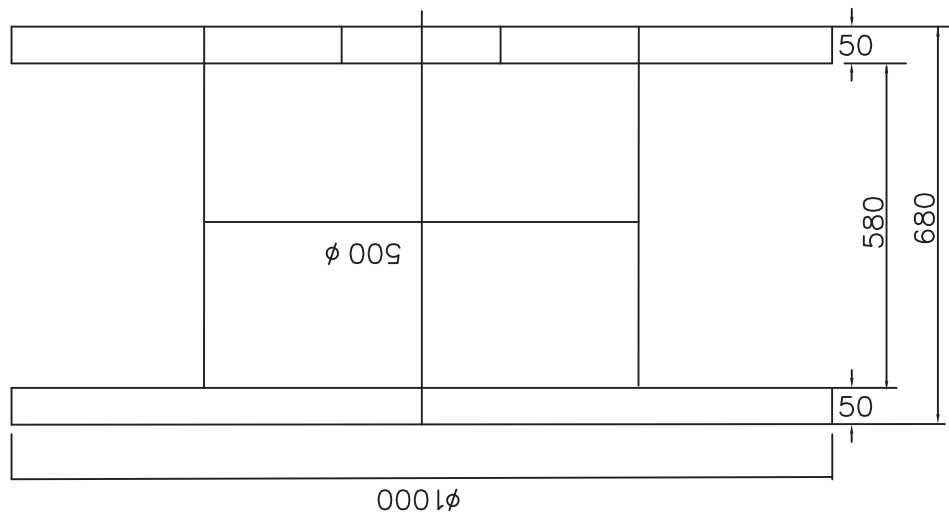
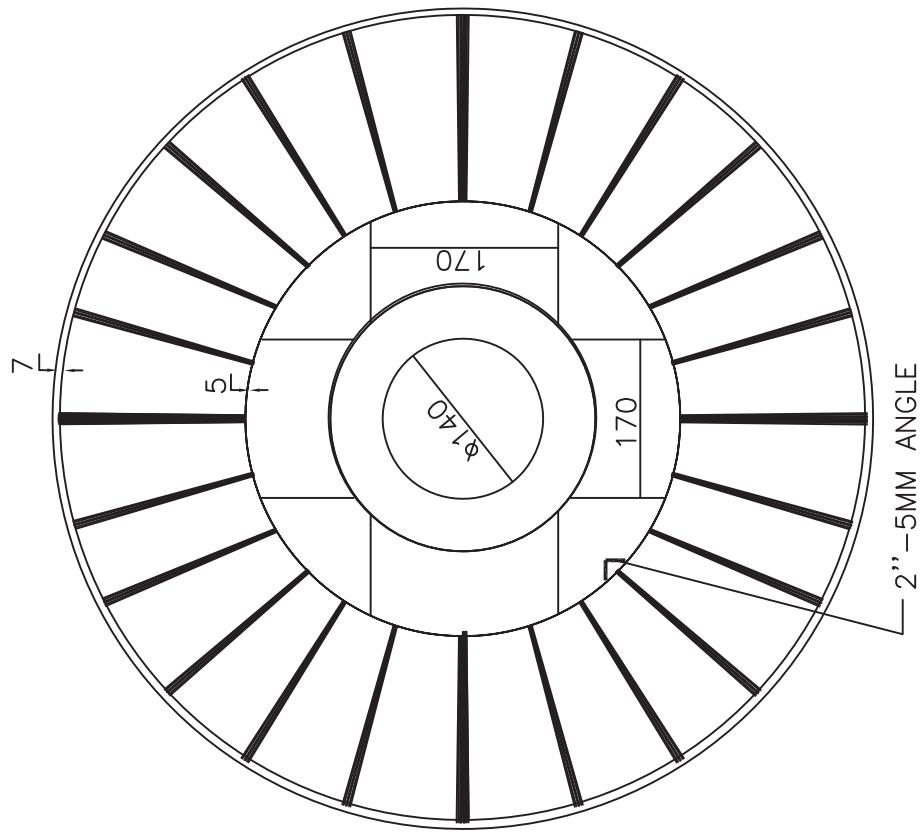
STEEL DRUM DRAWING (TYPICAL)

Annexure-B to Section II

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DIMENSION in mm



DIMENSION in mm

QUALITY PLAN		CUSTOMER : NTPC - TELENGANA	PROJECT : 3 X 800 MW PATRATU TPS		SPECIFICATION : PE-TS-434-507-E004					
SHEET 1 OF 5		BIDDER/ VENDOR	QUALITY PLAN		SPECIFICATION					
			NUMBER: PE-QP-999-507-E004, REV 01.		TITLE					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	SYSTEM		SECTION		VOLUME II	REMARKS		
			CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT			ACCEPTANCE NORM	FORMAT OF RECORD
1	2	3	4	5	6	7	8	9	10	11
Instructions: 1. Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch/ lot no. should be traceable to the final cable drum number or batch no. 2. Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not.										
1.0	RAW MATERIAL									
1.1	Copper Rods/ Wires (For Conductor & drain wire)	GENERAL : 1. Physical properties 2. Elec.Properties SPECIFIC CHECKS : a) Make b) Grade c) Resistivity	MA	Physical Tests	Sample	Relevant Standard/ Approved datasheet	Relevant Standard/ Approved datasheet	Inspection Report/ Test Cert.	-	1/2
			MA	Electrical Tests	Sample	-do-	-do-	-do-	-	1/2
			MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	Log book/ Test Cert.	-	1
			MA	-do-	-do-	IS 613/ Approved datasheet	IS 613/ Approved datasheet	-do-	-	1
			MA	Electrical Tests	Manufacturer	IS 613	IS 613	-do-	-	1
1.2	PVC Compound (for insulation)	GENERAL : 1. Physical properties 2. Elec.Properties SPECIFIC CHECKS : a) Make b) Type/ Grade c) Shelf life/ Storage condition	MA	Physical Tests	Sample	Relevant Standard/ Approved datasheet	Relevant Standard/ Approved datasheet	Inspection Report/ Test Cert.	-	1/2
			MA	Electrical Tests	Sample	-do-	-do-	-do-	-	1/2
			MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	-	1
			MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	-	1
			MA	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	-	1
1.3	Screen / Tapes/ Binders	1. Make 2. Dimension 3. T. S. & Elongation 4. Chem. & Phys. Properties	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	TC & IR	-	1/2
			MA	Measurement	Manufacturer std.	Manufacturer datasheet/ Approved datasheet	Manufacturer datasheet/ Approved datasheet	TC & IR	-	1/2
			MA	Physical Tests	-do-	Manufacturer datasheet	Manufacturer datasheet	-do-	-	1/2
			MA	Chemical & Physical Tests	-do-	Manufacturer std.	Manufacturer std.	-do-	-	1/2
BHEL			PARTICULARS			BIDDER/VENDOR				
			NAME							
			SIGNATURE							
			DATE							
									BIDDER'S/VENDORS COMPANY SEAL	

PROJECT : 3 X 800 MM PATRATU TPS		CUSTOMER :		TITLE		SPECIFICATION : PE-TS-434-507-E004						
QUALITY PLAN		BIDDER/ VENDOR		QUALITY PLAN		SPECIFICATION :						
SHEET 2 OF 5		SYSTEM		ITEM-INSTRUMENTATION CABLES		TITLE						
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY	SECTION	VOLUME III	REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.4	Fillers (as applicable)	1. Type 2. Flame retardant & moisture resistant (as applicable)	MA	Verify Chemical/ Environ.	-do- -do-	Approved datasheet -do-	Approved datasheet -do-	-do- -do-	3/2 3/2	- -	1 2	
1.5	Galvanised steel wire/strip for Armour (if applicable)	GENERAL : 1. Make 2. Dimension 3. Phy.and Elec. Properties 3.Galvanization Quality	MA	Verify Measurement Physical & Electrical Tests Galv. Tests	Manufacturer std. -do- Sample* -do-	Manufacturer approved source -do- Relevant Standard/ Appd. Data Sheet/ -do-	Manufacturer approved source -do- Relevant Standard/ Appd. Data Sheet/ -do-	Inspection Report/ Test Cert. -do- -do- -do-	2/3 2/3 2/3	- - -	1 2 2	* Sample from each size/ Batch/Lot.
1.6	PVC compound for Sheath	GENERAL : 1. Physical properties 2. Elec.Properties 3. FRLS Properties (as applicable)	MA	Physical Tests Electrical Tests Chemical/ Environ.	Sample Sample Sample	Relevant Standard/ Approved datasheet -do- -do-	Relevant Standard/ Approved datasheet -do- -do-	Log book/ Test Cert. -do- -do-	3/2 3/2 3/2	- - -	1/2 1/2 1/2	
		SPECIFIC CHECKS : a) Make b) Type/ Grade c) Shelf life/ Storage condition	MA	Verify -do- -do-	100% -do- -do-	Manufacturer approved source Approved datasheet Compound Manufacturer std.	Manufacturer approved source Approved datasheet Compound Manufacturer std.	Log book/ Test Cert. -do- -do-	3/2 3/2 3/2	- - -	1 1 1	
1.7	Wooden drums	1. Phy. & Constructional checks 2. Anti termite treatment	MA	Visual Chem.	Mfr's Plant Std. -do-	IS 10418 Mfr's Plant Std.	IS 10418 Mfr's Plant Std.	Log book/ Test Cert. COC	3/2 3/2	- -	1 1	
1.8	Steel drums	1. Dimension 2. Surface finish	MA	Meas. Meas.	Mfr's Plant Std. -do-	Mfr's Plant Std. -do-	Mfr's Plant Std. -do-	Log book/ Test Cert. -do-	3/2 3/2	- -	1 1	
2.0	IN PROCESS											
2.1	Wire Drawing & Annealing.	1. Size 2. Surface finish 3. % of Elongation	MA	Dimensional Visual Mechanical	Mfr's Plant Std. -do- -do-	Approved datasheet Surface shall be smooth IS 8130	Approved datasheet Surface shall be smooth IS 8130	Inspection Report	2	-	1	
2.2	Tinning (Conductor or drain wire)	1. Size 2. % of Elongation	MA	Dimensional Mechanical	Plant Mfg. Std. -do-	Approved datasheet IS 8130	Approved datasheet IS 8130	Log Book	2	-	1	(Applicable only for tin-coated copper conductor and drain wire)
2.3	Stranding of wires	1. No.of wires	MA	Counting	Mfr's Plant Std.	IS 8130/ Appd. Data Sheet	IS 8130/ Appd. Data Sheet	-do-	2	-	-	
BHEL		PARTICULARS		BIDDER/VENDOR								
		NAME										
		SIGNATURE										
		DATE										
												BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN			CUSTOMER :		PROJECT : 3 X 800 MW PATRATU TPS		SPECIFICATION : PE-TS-434-507-E004												
				BIDDER/ VENDOR :		QUALITY PLAN		NUMBER : PE-QP-999-507-E004, REV. 0.		SPECIFICATION :											
				SYSTEM		ITEM :INSTRUMENTATION CABLES		TITLE		VOLUME III											
SHEET 4 OF 5		CHARACTERISTICS CHECK		CAT. TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		ACCEPTANCE NORM		FORMAT OF RECORD		AGENCY		SECTION		REMARKS			
SL. NO.				4		5		6		7		8		9		10		11			
1		2		3		MA		Visual		100%		--		Free from bulging, burnt particles,lumps cuts & scratches.		-do-		2		-	
2.6		Inner Sheath Extrusion (If applicable)		1. Surface finish		MA		Measurement		Sample				Relevant Standard/ Appd. Data Sheet		-do-		2		-	
				2. Sheath thickness		MA		Measurement		Sample				Relevant Standard/ Appd. Data Sheet		-do-		2		-	
				3.Dia over inner sheath		MA		Measurement		Sample				Relevant Standard/ Appd. Data Sheet		-do-		2		-	
				4. Colour		MA		Visual		100%				Relevant Standard/ Appd. Data Sheet		-do-		2		-	
2.7		Armouring (If Applicable)		1. No.of wires/Strips		MA		Counting		At the start of the process				Relevant Standard/ Appd. Data Sheet		-do-		2		-	
				2. Size of wire/ Strip		MA		Measurement		-do-				-do-		-do-		2		-	
				3. Lay Direction		MA		Visual		-do-				-do-		-do-		2		-	
				4. Lay Length		MA		Visual, Meas.		At the start of the process				Relevant Standard/ Appd. Data Sheet		Log Book		2		-	
				5. Coverage		MA		Measurement		-do-				Relevant Standard/ Appd. Data Sheet		-do-		2		-	
				6. Dia over armouring		MA		Measurement		-do-				-do-		-do-		2		-	
2.8		Outer Sheath Extrusion		1. Surface Finish		MA		Visual		100%		-		Free from Bulging Burnt particles, lumps, cuts & scratches		Log Book		2		-	
				2.Sheath thickness		MA		Measurement		Sample				Relevant Standard/ Appd. Data Sheet		Log Book		2		-	
				3. Dia over outer sheath		MA		Measurement		Sample		-do-		-do-		-do-		2		-	

		QUALITY PLAN		CUSTOMER :		PROJECT : 3 X 800 MW PATRATU TPS		SPECIFICATION : PE-TS-434-507-E004			
COMPONENT/OPERATION		CHARACTERISTICS CHECK		SYSTEM		QUALITY PLAN		SPECIFICATION :			
SHEET 5 OF 5		CAT. TYPE/ METHOD OF CHECK		EXTENT OF CHECK		REFERENCE DOCUMENT		TITLE			
SL. NO.											
1	2	3	4	5	6	7	8	9	10	11	
		4. Marking/ Colour/ Embossing	MA	Visual	100%	Appd. Data Sheet	Appd. Data Sheet	Test Report	2	-	Sequential marking shall be done by printing
		5. TS & % Elongation	MA	Mechanical	100%	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	-do-	2	-	
		1. Finish & Length	MA	Visual	(See remark)	Relevant Standard/ Appd. Data Sheet	Free from Bulging Burnt particles, lumps, cuts & scratches	Inspection Report	2	1	One drum in a Lot
		2. Dimensions	MA	Measurement	Sample Lengths	Appd. Data sheet	Appd. Data sheet	Inspection Report	2	1	-
		3. Armouring - Coverage No.of Wires/Strips	MA	Visual & Meas.	Sample	-do-	-do-	-do-	2	1	-
		4. Marking/Colour/ pair identification	MA	Visual	-do-	-do-	-do-	-do-	2	1	-
		5. Test for screening	CR	Elect. Test	-do-	-do-	-do-	-do-	2	1	Refer Annexure to QP for sampling plan.
		6. Acceptance Tests	CR	Phy & Elect. Tests	sample	-do-	-do-	-do-	2	1	-
		7. Type & FRLS Tests	CR	Measurement	Sample	Appd. Data sheet	Appd. Data sheet	-do-	2	1	-
NOTES:- (A) JOINTS IN WIRE SHALL BE AS PERMITTED BY REL STD / BHEL SPECIFICATION. VENDOR TO CERTIFY THE SAME. (B) NO REPAIR OF CORE INSULATION PERMITTED (C) CABLE ENDS SHALL BE SEALED AS PER REL. STD./ BHEL SPECIFICATION (D) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER. (E) FILLERS/DUMMY CORES ETC. SHALL BE AS PER BHEL SPECIFICATION (F) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES AND NOT DEFINED IN QP, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN AGREED BY PURCHASER. (G) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER REL. STD./ BHEL SPECIFICATION. (H) FOR LIST OF TYPE TESTS, ROUTINE TESTS & ACCEPTANCE TESTS; REFER ANNEXURE TO QAP.											
LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL/CUSTOMER 2-VENDOR 3 SUB VENDOR CHP: CUSTOMER HOLD POINT TC : Test Certificates, Spec. : Specification Mfg. : Manufacturer.											
BHEL		PARTICULARS		BIDDER/VENDOR							
		NAME									
		SIGNATURE									
		DATE									
				BIDDER'S/VENDORS COMPANY SEAL							

	ANNEXURE C TO QP	CUSTOMER: NTPC	PROJECT TITLE: 3X800 MW PATRATU TPS	SPECIFICATION NUMBER: PE-TS-434-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0	SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLE
	SHEET	1 of 4	ITEM: SCREENED CONTROL CABLES (AS PER VDE)	DOC. NO.

TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS (AS PER VDE)

A. Type Test Conduction:

- Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.
- Sampling:
 - Type tests (except for Sl. no. b & c below) to be conducted on one size (2P, 4P etc.) of each type (F or G type)/ lot.
 - Electrical & C&I tests to be conducted on each size of each type of cables /lot.
 - FRLS & Flammability tests to be conducted only on one sample/ lot, irrespective of size/type.

B. Acceptance Test Conduction:

- Tests for which "A" is indicated in the 'Test Conduction Required As' column below shall be conducted as Acceptance tests.
- Sampling:
 - Acceptance tests (except for Sl. no. b & c below) for every lot shall be as per Appendix-B (Clause 15.2.2) of IS: 1554 Part-I.
 - Electrical & C&I tests to be conducted on each size of each type of cables /lot.
 - FRLS & Flammability tests to be conducted only on one sample/ lot, irrespective of size/type.

C. Routine Test Conduction:

- Tests for which "R" is indicated in the 'Test Conduction Required As' column below shall be conducted as Routine tests.
- Sampling:
Routine testing shall be conducted in line with the applicable standards and as per the Manufacturing Quality Plan approved for the project for every lot offered for inspection.

D. ADS: Approved datasheet.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	Tests for Conductor				
I.	Annealing test	For copper conductor only	T, A	IS 10810 Pt 1	<i>Internal in process Test Report to be furnished for both type & acceptance tests</i>
II.	Tin coating test (for tinned copper)	For copper conductor only	T, A	IS 10810 Pt 4	
III.	Resistance test	For Al/Cu	T, A, R	VDE 0815	

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

	ANNEXURE C TO QP	CUSTOMER: NTPC	PROJECT TITLE: 3X800 MW PATRATU TPS	SPECIFICATION NUMBER: PE-TS-434-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0	SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLE
	SHEET	2 of 4	ITEM: SCREENED CONTROL CABLES (AS PER VDE)	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
IV.	Diameter test	For conductor	T, A	ADS	
2.0 Tests for Armour Wires/Strips					
I.	Measurement of dimensions	Applicable for Aluminium wire & GS wire/Strip	T,A	IS 10810 Pt 36	
II.	Tensile test	Applicable for Aluminium wire & GS wire/Strip	T, A	IS 10810 Pt 37	
III.	Elongation at break test	Applicable for GS wire/Strip only	T, A	IS 10810 Pt 37	
IV.	Torsion test	For GS round wire only	T, A	IS 10810 Pt 38	
V.	Winding test	For GS strip only	T, A	IS 10810 Pt 39	
VI.	Resistivity test	Applicable for Aluminium wire & GS wire	A	IS 10810 Pt 42	
VII.	Uniformity of Zinc coating test	For G. S. wires/Strip only	A	IS 10810 Pt 40	
VIII.	Mass of Zinc coating test	For G. S. wires/Strip only	A	IS 10810 Pt 41	
IX.	Wrapping Test	For Aluminium wires only	A	IS 10810 Pt 3	
3.0 Physical Tests for PVC Insulation & PVC sheath					
I.	Test for thickness & Eccentricity	Applicable for PVC insulation, PVC inner sheath & PVC outer sheath	T, A	VDE 0472	
II.	Tensile strength and elongation test at break	Applicable for PVC insulation, PVC inner sheath & PVC outer sheath		VDE 0472	
(a)	Before ageing		T, A		
(b)	After ageing		T, A		
III.	Ageing in air oven	Applicable for PVC insulation & PVC outer sheath	T	VDE 0472	
IV.	Loss of mass in air oven test	For PVC insulation, PVC inner & PVC outer sheath	T	VDE 0472	
V.	Hot deformation test	For PVC insulation, PVC inner & PVC outer sheath	T	VDE 0472	
VI.	Heat shock test	For PVC insulation, PVC inner & PVC outer sheath	T	VDE 0472	
VII.	Shrinkage test	For PVC insulation, PVC inner & PVC outer sheath.	T	VDE 0472	
VIII.	Thermal stability test	For PVC insulation, PVC inner & PVC outer sheath	A	VDE 207	
IX.	Bleeding & Blooming Test	For PVC insulation & outer sheath.	T	IS 10810 Pt 19	

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

	ANNEXURE C TO QP	CUSTOMER: NTPC	PROJECT TITLE: 3X800 MW PATRATU TPS	SPECIFICATION NUMBER: PE-TS-434-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0	SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLE
	SHEET	3 of 4	ITEM: SCREENED CONTROL CABLES (AS PER VDE)	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
X.	Cold Bend & Cold Impact test	For PVC inner & outer sheath.	T	VDE 0472	
XI.	Core marking, end sealing	For PVC insulation, PVC inner & PVC outer sheath	A	VDE-207	
4.0	Tests for Al-Mylar Shield				
I.	Continuity test	For Al-Mylar shield	T, A	Plant Standard	
II.	Shield thickness	For Al-Mylar shield	A	ADS	
III.	Overlap test	For Al-Mylar shield	A	ADS	
IV.	Constructional details, dimensions	For Al-Mylar shield	A	ADS	
V.	Visual, surface finish+	For Al-Mylar shield	A	Plant Standard	
VI.	Overall coverage	For Al-Mylar shield	A	Plant Standard	
VII.	Noise interference test.	For Al-Mylar shield	T,A	ADS	
5.0	Tests for Drain Wire				
I.	Annealing test	For copper conductor only	T, A	IS 10810 Pt 1	<u>Internal in process Test Report to be furnished for both type & acceptance tests</u>
II.	Tin coating test (for tinned copper)	For copper conductor only	T, A	IS 10810 Pt 4	
III.	Resistance test	For Al/Cu	T, A, R	VDE 0815	
IV.	Diameter test	For conductor	T, A	ADS	
V.	Continuity test	For Al-Mylar shield	T, A	Plant Standard	
6.0	FRLS Tests				
I.	Oxygen index test	For PVC outer sheath & Filler	T, A	IS 10810 Pt 58 / ASTM D 2863	<u>Applicable for Inner Sheath if the same is indicated in Datasheet-A</u>
II.	Smoke density test	For PVC outer sheath only	T, A	ASTM D 2843	
III.	Acid gas generation test	For PVC outer sheath only & Filler	T, A	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	For PVC outer sheath only	T	IS 10810 Pt 64 / ASTM D 2863	
7.0	Flammability Tests				

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

	ANNEXURE C TO QP	CUSTOMER: NTPC	PROJECT TITLE: 3X800 MW PATRATU TPS	SPECIFICATION NUMBER: PE-TS-434-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0	SPECIFICATION TITLE: TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLE
	SHEET	4 of 4	ITEM: SCREENED CONTROL CABLES (AS PER VDE)	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
I.	Flammability test for bunched cables	For complete cable	T,A	IS 10810 Pt 62/ IEC-60332 (Part- 3-23, CAT A/ CAT B.	<u>Test & Category applicable as indicated in Datasheet-A</u>
II.	Flammability test for single cable	For complete cable	T,A	IS: 10810 Pt 61 / IEC:60332 Part-1	
III.	Swedish chimney test	For complete cable	T,A	SEN SS 424 1475 (Class F3)	
IV.	Flammability test	For complete cable	T,A	IEEE: 383	
8.0	Electrical Tests				
I.	High Voltage Test	For complete cable	T, A, R	VDE 0815	
II.	Insulation Resistance Test (Volume resistivity method)	For complete cable	T, A, R	IS 10810 Pt 43	
III.	Conductor resistance	For complete cable	A,R	VDE 0815	
IV.	Spark test	Insulation	R	VDE 0207	
9.0	C&I Tests				
I.	Cross talk	For complete cable	T, A	ADS	
II.	Attenuation	For complete cable	T, A	ADS	
III.	Characteristic Impedance	For complete cable	T, A	ADS	
IV.	Mutual capacitance	For complete cable	T, A	ADS	
V.	Noise interference	For complete cable	T, A	ADS	
10	Complete Cable				
I.	Visual , surface Finish	Overall Cable	A	Plant Standard	
II.	Volume resistivity at room and elevated temperature	Overall Cable	A	IS 10810 Pt43/ ADS	
III.	Construction details, dimensions	Overall Cable	T, A	ADS	

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

INSTRUMENTATION CABLE																
ITEMS	TESTS															
		Conductor Resistance ® & (A)	High Voltage ® & (A)	Insulation Resistance ® & (A)	Constructional detail, dimensions (A)	Outer-Sheathe/core marking, end sealing (A)	Thermal Stability (A) +	Visual, Surface finish (A) +	Electrical Parameters ** (A) +	Persulphate Test (A) +	Overall/Coverage/Continuity (A)	Swidesh chimney Test (SS-4241475) (A) ++	FRLS Test * (A) ++	Tensile & Elongation before & after aging (A) ++	Vol. Resistivity. at room & Elevated Temp. (A) ++	Spark test report review ®
1. Instrument cable twisted and shielded																
Conductor(IS-8130)		Y			Y			Y								
Insulation(VDE-207)					Y	Y	Y	Y						Y		Y
Pairing/Twisting					Y	Y		Y								
Shielding					Y			Y		Y						
Drain wire		Y			Y			Y		Y	Y					
Inner Sheath					Y	Y	Y	Y					Y	Y		
Outer Sheath					Y	Y	Y	Y					Y	Y		
Over all cable		Y	Y	Y	Y	Y		Y	Y			Y			Y	
Cable Drums(IS-10418)					Y			Y								
Note : High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.																
Note : This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.																
Note : ® - Routine Test A - Acceptance Test Y - Test Applicable																
Note : Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)																
• * FRLS Tests: Oxygen / Temp Index (ASTM D-2863), Smoke Density Rating (ASTM – D 2843), HCL Emission (IEC-754-1)																
• ** Characterisitic Impedence, Attenuation, Mutual Capacitance, Cross Talk (As applicable)																
+ Sample size will be One No. of each size/type per lot.																
++ Sample size will be One No. sample for complete lot offered irrespective of size/type.																