TELANGANA STATE POWER GENERATION CORPORATION LIMITED
YADADRI TPS, 5X800MW

VOLUME-II

TECHNICAL SPECIFICATION

FOR

SCREENED CONTROL CABLE

SPECIFICATION NO: ***PE-TS-417-507-E005***

REVISION: **00**

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

	TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES 5X800MW YADADRI TPS	SPECIFICATION NO. PE-TS-417-507-E005	
		VOLUME II	
		SECTION: CONTENTS	
		REVISION 0	DATE: 12.03.2023
		SHEET 1 OF 1	

CONTENTS

	TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES 5X800MW YADADRI TPS	SPECIFICATION NO. PE-TS- 417-507-E005	
		VOLUME II	
		SECTION I	
		REVISION 0	DATE: 12.03.2023
		SHEET 1 of 1	

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 deviations 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

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

	TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES	SPECIFICATION NO. PE-TS-417-507-E005	
		VOLUME II	
		SECTION: I	
		REVISION 0	DATE: 12.03.2023
	5X800MW YADADRI TPS	Sheet 2 of 3	

1.0 PURPOSE

This specification is intended for finalization of contract between BHEL PEM and Bidder. Standard technical detail as indicated in the specification shall be agreed upon between BHEL PEM and bidder.

2.0 SCOPE OF ENQUIRY

2.1 Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of Screened Control Cable conforming to this specification.

2.2 It is not the intent to specify herein all the details of design & manufacture of material. However, the material shall conform in all respects to high standard of design, engineering & workmanship and shall be capable of performing in continuous commercial operation at site condition.

2.3 Technical requirements of Screened Control Cable are indicated in Data Sheet-A & Section-II.

2.4 The stipulation of Data Sheet-A shall prevail in case of any conflict between the stipulations of Data Sheet-A & Section-II.

2.5 The documents shall be in English language and MKS system of units.

3.0 TECHNICAL

S.No	Reference clause No. of Section II (if any)	Specific Requirement/ Change
1	3.1	Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E004, Rev-2) 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 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.
2	4.2	BIS certification mark on drum is not required.
3	3.4	UV Radiation test & Hydrolytic Stability test not applicable

4.0 BILL OF QUANTITIES

The bidder to quote for items as BOQ-cum-price schedule attached with NIT.
Bidder's offer shall be for complete scope as per specification. Part offers are not acceptable.

5.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

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

Sl. No.	Drawing / Document Description	Drawing / Document no	Document Type
1	Technical Data sheet – Screened Control cables	PE-V2-417-507-E141	Primary
2	Cross-sectional Drgs.- Screened Control Cables	PE-V2-417-507-E143	Primary

3	Quality Plan - Screened Control Cables	PE-V2-417-507-E916*	Primary
4	Type Test Reports - Screened Control Cables	PE-V2-417-507-E142	Secondary

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

5.2 Drawings/documents shall be submitted through Document Management System (DMS).

5.3 Supplier to submit the drawing/documents submission/resubmission schedule as & when required by BHEL.

5.4 Supplier to submit detailed 'bill of material' (BoM) at the time of drawing/document submission after placement of PO. Each item of the BoM to be uniquely identified with item code no. or item serial no.

5.5 Supplier to ensure that all items which will find separate mention in the packing list are covered in this detailed BoM.

5.6 Supplier to also give the following undertaking in the BOM:

"The BoM provided herewith completes the scope (in content and intent) of material supply under PO No. ----------, dated ---------.

Any additional material which may become necessary for the intended application of the supplied item(s)/package will be supplied free of cost in most reasonable time."

	TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES 5X800MW YADADRI TPS	SPECIFICATION NO. PE-TS-417-507-E005	
		VOLUME II	
		SECTION I	
		REVISION 01	DATE: 12.03.2023
		SHEET 1 of 5	

DATA SHEET-A
PARAMETERS PREFILLED ARE MANDATORY REQUIREMENT

S.No.	Particulars	Unit	Description
1	Manufacturer's name	-	
2	Reference design standards	-	IS:1554 (Part-1), IS:8130, IS:5831, , IS:3975, IS:694, SEN-SS424-1475, Class F3, IEEE-383, IS:10810 Part 62, Cat-B, ASTMD:2843, ASTMD:2863, ASTM D 3137:81, IEC-60754-1, IEC:60332 Part-1, IEC:60332 Part-3-23, Cat-B.
3	Conductor size	sq. mm	0.5
4	Rated Voltage	V	1100
5	Number of pairs	No.	As per BOQ Cum Price Schedule
6	Cable suitable for both earthed & unearthed system	-	Both
7	Conductor		
	a) Material	-	Annealed High Conductivity, Stranded Tinned Copper(Class-2)
	b) Reference Standard	-	IS: 8130
	c) Grade	-	Electrolytic
	d) No. of strands	No.	7
	e) Diameter of strands (nom.)	mm	0.3
	f) Approx. dia of conductor	mm	0.8mm minimum
	g) Cross Section area	sq. mm	0.5
	h) Maximum conductor resistance per Km at 20°C	ohm	78
8	Insulation		
	a) Reference Standard	-	IS: 5831
	b) Material composition	-	HR PVC TYPE-C
	c) Application	-	Extruded
	d) Minimum thickness	mm	
	e) Nom.Thickness	mm	0.6 as per IS-694
	f) Max. thickness	mm	
	g) Minimum volume resistivity as per IS 5831	Ohm cm	1 X 10^{13} at 27° C 1 x 10^{10} at 85° C
	h) Dielectric constant	-	15-25
	i) Maximum conductor temperature withstand capacity	°C	160

	j) Core diameter including insulation	mm	
9	Core laying		
	a) Whether cores/pairs are twisted.	-	Yes
	b) Minimum no. of twists per meter.		
	c) Maximum lay of Twin twist	mm	60
	d) Identification of cores/pairs	-	As per Annexure B-I
10	Individual Shield		
	a) Material	-	Aluminium-Mylar tape
	b) Thickness of tape	micron	28
	c) Coverage/ Overlap	%	100% Coverage & 25 % min Overlap
	d) Noise interference better than	dB	
11	Drain wire for individual shield		
	a) Reference standard	-	IS:8130
	b) Size (No. of strands x dia. of each strand)	sq. mm (no. x mm)	$0.5mm^2$(7 x 0.3mm)
	c) Material	-	Multi stranded Annealed Tinned Copper
	d) Resistance of drain wire per km at 20 deg.C	ohm	
12	Overall shield		
	a) Material	-	Aluminium-Mylar tape
	b) Thickness of tape	mm	60
	c) Coverage/Overlap	%	100% Coverage & 25 % min Overlap
	d) Noise interference better than	dB	
13	Drain wire for overall shield		
	a) Reference standard	-	IS:8130
	b) Size (No. of strands x dia. of each strand)	sq. mm (no. x mm)	$0.5mm^2$(7 x 0.3mm)
	c) Material	-	Multi stranded Annealed Tinned Copper
	d) Resistance per Km (with shield) at 20°C	Ohm/ km	
14	a) Fillers: Material (if applicable)		Same as inner sheath (with moisture resistant / non hygroscopic properties)
	b) Bedding Material		Mylar tape
15	Inner sheath		
	a) Material, type and standard	-	FRLSH HR- PVC TYPE ST-2 as per IS:5831
	b) Whether FRLS	-	Yes
	c) Colour	-	Black
	d) Method of application	-	Extruded (With filler Pressure/Vacuum extruded) & (Without fillers Pressure extruded)

	e) Thickness (min)	mm	As per Table-4 of IS: 1554 (Part-1)
16	RIP CORD		A non-hygroscopic and non-wicking non-metallic cord
17	Armour		IS:3975
	a) Material	-	Galvanised Steel Wire/Strip, conforming to IS 3975.
	b) Formed wire / round wire		
	c) Minimum Coverage	%	90 (Gap between armour wires shall not exceed one armour wire space {No cross-over/ overriding})
	d) Method of jointing	-	Welding
	e) Breaking load of joint	-	95% of normal armour
	f) Size (approx.) of strip	mm	
	g) Dia of armour	mm	
	h) No. of wires/ strip.	No.	
18	Outer sheath		Resistant to water, oil, acid, alkali, termite & rodent attack
	a) Reference standard	-	IS: 1554 Part-1 & IS: 5831
	b) Material	-	Extruded FRLSH HR- PVC TYPE ST-2 as per IS:5831 (anti rodent, anti termite & moisture resistant properties)
	c) Minimum thickness of sheath	mm	IS: 1554 (Part-1) & IS: 5831
	d) Calculated dia under outersheath	mm	
	e) Oxygen index (as per ASTMD 2863)	-	29% (min)
	f) Temperature index (in deg. C as per ASTMD 2863)	deg. C	250 Deg.C (min)
	g) Maximum acid gas generation as per IEC754-1	%	20% (max)
	h) Maximum smoke density rating as per ASTMD 2843	%	60% (max)
	i) Colour of outer sheath	-	Grey
19	Dia over laid-up core	mm	
20	Dia under armour	mm	
21	Dia above armour	mm	
22	Overall diameter of cable	mm	
23	Tolerance on overall diameter	mm	(+/-2mm)
24	Weight of		
	Copper (conductor & drain wire)	Kg/ km	
	PVC (insulation, sheath & fillers)	Kg/ km	
	Armour	Kg/ km	
	Cable (approx.)	Kg/ km	
25	Cable parameters at 20°C(+/-3 deg. C)		

	a) Conductor resistance (max)	Ohm/ km	78(Tinned)
	b) Insulation resistance (min)	M-Ohm/ km	100
	c) Mutual capacitance at 0.8KHz (max)	nF/ km	120
	d) Cross talk at 0.8KHz (min)	dB	60
	e) Attenuation at 1 KHz (max)	dB/ km	1.2
	f) Characteristic impedance at 1 KHz (max)	Ohm	320(F type) & 340 (G type)
25	Continuous operating temp. (deg.C)	deg. C	85
26	(a) Relevant IS standard including Part & category for Flame retardance of complete cable	-	IS : 10810 P-61 & IS: 10810 P-62 cat B
	(b) Relevant IEC standard including Part & category for Flammability of complete cable		IEC 60332-1 & IEC 60332-3 cat B
	Flammability test as per IEEE: 60383		Yes
27	Whether complete cable passes Swedish Chimney test as per SEN 4241475 (F3)	-	Yes
28	Identification		
	a) Length of cable marked at every mtr.	-	Yes
	b) FRLS marked at every 5 mtrs	-	Yes
	c) Each core of the pair numbered	-	Yes
	d) Conductor identification details for pairs	-	On Outer Sheath As per Annexure B-I
	e) Details of cable markings	-	Cable size (cross section area and no. of pairs), voltage grade, Type of Insulation e.g. HRPVC, FRLS, Manufacturer's name and/ or trade name, and year of manufacture @ 5m (by embossing) 'BHEL-PEM' and 'TSGENCO' Name @5m (by embossing) Progressive sequential length marking @ 1m. (by printing) Further customer specific marking requirement (if any) shall be informed later.
29	Test voltage		
	a) High voltage test/ Dielectric Strength		
	i) Voltage (KV), Core - Core	kV	2
	ii) Duration	min	1
	b) High Voltage test		

	i) Voltage (KV), Core - Screen	kV	2
	ii) Duration	min	1
	c) Resistance to direct current test (applicable for 225 V cable as per VDE)	-	
	Voltage	V	
	Duration	hrs/days	
30	Min bending radius	NoxOD	12 X OD
31	Ovality at any cross section	mm	Maximum 1mm
32	Variation of dia through out cable length	mm	Maximum 1mm
33	Cable cross-sectional drawings for each type of cable furnished		Yes
34	i) Length of single coil in a drum	M	1000 Mtr
	Cable Drum Material Type		Non-returnable wooden drums as per IS 10418, with tolerance +/-5%, Entire surface painted, Anti rodent, outermost layer to be covered with waterproof polyethylene
	ii) Marking on drum	-	Each drum shall carry manufacturer's name or trade make, purchaser's name, address and contract no., Type of cable & voltage grade, Year of manufacture, Type of insulation e.g. HRPVC item no., No. of pairs and size of cables & Type, Cable code e.g. FRLS, No. of length on drum, if more than one, length of cable and net gross weight stencilled on both sides of drum. A tag containing same information shall be attached to the leading end of the cable. An arrow & suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled
	iii) Seasoned wood drum provided	-	Yes
	iv) Both ends of cable to be sealed with PVC/ Rubber caps to prevent water/ moisture ingress	-	Yes
	v) Gross weight (approx.)	kg.	
	vi) Net weight (approx.)	kg	
35	Type test procedures as per BHEL Technical Spec. and other relevant standards enclosed.	-	Yes
36	Anti termite & rodent test	-	Yes

ANNEXURE: B

CORE IDENTIFICATION / PAIR IDENTIFICATION

ANNEXURE: B-I

The cable cores shall be colour coded as mentioned below:

PAIR	CORE	COLOUR
1st	1st	Blue
1st	2nd	Red
2nd	1st	Grey
2nd	2nd	Yellow
3rd	1st	Green
3rd	2nd	Brown
4th	1st	White
4th	2nd	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 indelible printed colour bands for cables of more than 4-pair. Eg. All eight cores of the first unit shall have a single band of pink color (preferably rose pink).

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

The dimension L (distance between the markings) shall be limited to 50 mm. 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.

Band markings shall not be easily erasable and shall also meet Bleeding and Blooming Test and color fastness to water test requirement as per relevant standard.

SECTION-II

STANDARD TECHNICAL REQUIREMENTS

1.0 CODES AND STANDARDS

1.1 The material shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the material is to be installed.

1.2 The design, material, construction, manufacture, inspection and testing of Screened Control Cable shall conform to the latest revision of relevant standards as per Data Sheet-A.

1.3 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

2.0 TECHNICAL REQUIREMENTS

2.1 Screened Control Cable shall be supplied as per technical particulars specified in Data Sheet – A.

3.0 QUALITY ASSURANCE, TESTING & INSPECTION

3.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E004, Rev-1) 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, routine / acceptance testing and special testing requirements shall be as per Annexure –I to QP. Charges for all these tests for all the equipment & 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.

4.0 PACKING

4.1 Cables shall be supplied in non-returnable drums. Material of cable drums shall be wooden.

4.2 For wooden drums, all wooden parts shall be manufactured from seasoned wood treated with copper napthenates / zinc napthenates (refer IS: 401) and anti-termite. 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. 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.

4.3 Each drum shall carry manufacturer's name or trade make, purchaser's name, address and contract no., Type of cable & voltage grade, Year of manufacture, Type of insulation e.g. HRPVC item no., No. of pairs and size of cables & Type, Cable code e.g. FRLS, No. of length on drum, if more than one, length of cable and net gross weight stencilled on both sides of drum. A tag containing same information shall be attached to the leading end of the cable. An arrow & suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

Supplier Logo	MANUFACTURING QUALITY PLAN	SPEC. NO : PE-RC-999-507-E005 Rev: 00	DATE: 15/02/2020
	CUSTOMER : TSGENCO	QP NO. : PE-V0 - 417-507-E916 Rev: 01	DATE: 02/11/2021
	PROJECT: 5 x 800 MW YADADRI TPS	PO NO.: R-31/21	DATE: 30/06/2021
	ITEM: Screened Control Cables	SYSTEM: Cable	Cat Plan –Cat-I	Page 1 of 8

SL NO.	COMPONENT /OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK			REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **			REMARKS
					M	C	N				D	M	C	N	
1	2	3	4	5	6			7	8	9		10			

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/Wire (For Conductor & drain wire)	**GENERAL**														
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	Sample/ Batch	IS -613	IS -613	Inspection Report / Test Certificate	✓	P/ V	V	V	
		2. Electrical Properties	MA	Electrical Tests	Sample/ Batch	Sample/ Batch	Sample/ Batch	-do-	-do-	-do-	✓	P/ V	V	V	
		SPECIFIC CHECKS													
		a) Make	MA	Verify	100%	100%	100%	Manufacturer approved source	Manufacturer approved source	COC / Test Certificate	✓	P	V	V	
		b) Grade	MA	-do-	-do-	-do-	-do-	IS -613	IS -613	-do-	✓	P	V	V	
		c) Resistivity	MA	Electrical Tests	Manufacturer std.	Manufacturer std.	Manufacturer std.	IS -613	IS -613	-do-	✓	P	V	V	
1.2	PVC Compound (for insulation)	**GENERAL**													
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	Sample/ Batch	IS -5813	IS - 5813	Inspection Report / Test Certificate	✓	P	V	V	
		2. Electrical Properties	MA	Electrical Tests	Sample/ Batch	Sample/ Batch	Sample/ Batch	-do-	-do-	-do-	✓	P	V	V	
		SPECIFIC CHECKS													
		a) Make	MA	Verify	100%	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Certificate	✓	P/ V	V	V	
		b) Type/ Grade	MA	-do-	-do-	-do-	-do-	Approved datasheet	Approved datasheet	-do-	✓	P/ V	V	V	

Supplier Logo	MANUFACTURING QUALITY PLAN	SPEC. NO : PE-RC-999-507-E005 Rev: 00	DATE: 15/02/2020
	CUSTOMER : TSGENCO	QP NO. : PE-V0 - 417-507-E916 Rev: 01	DATE: 02/11/2021
	PROJECT: 5 x 800 MW YADADRI TPS	PO NO.: R-31/21	DATE: 30/06/2021
	ITEM: Screened Control Cables	SYSTEM: Cable	Cat Plan –Cat-I	Page 2 of 8

SL NO.	COMPONENT /OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK			REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **			REMARKS
1	2	3	4	5	6			7	8	9	D				
					M	C	N					M	C	N	
		c) Shelf life/ Storage condition	MA	-do-	-do-	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	✓	P/ V	V	V	
1.3	Screen / Tape/ Binder	1. Make	MA	Verification	100%	100%	100%	Manufacturer approved source	Manufacturer approved source	Test Certificate/ Inspection Report	✓	P/ V	V	V	
		2. Dimension	MA	Measurement	Manuf acturer std.	Manuf acturer std.	Manuf acturer std.	Manufacturer data sheet / Approved data sheet	Manufacturer data sheet / Approved data sheet	Test Certificate/ Inspection Report	✓	P/ V	V	V	
		3. T.S. & Elongation	MA	Physical Tests	-do-	-do-	-do-	Manufacturer data sheet	Manufacturer data sheet	Test Certificate/ Inspection Report	✓	P/ V	V	V	
1.4	Fillers (as applicable)	1. Make	MA	Verify	100%	100%	100%	Manufacturer approved source	Manufacturer approved source	COC / Test Certificate	✓	P	V	V	Fillers material chosen shall be compatible with the temperature rating of the cable and shall have no deleterious effect on any other component of cable
		2. Flame retardant & moisture retardant (as applicable)	MA	Chemical / Environ	100%	100%	100%	Approved data sheet	Approved data sheet	COC / Test Certificate	✓	P/ V	V	V	
1.5	Galvanized steel wire/strip for Armour (as applicable)	GENERAL													
		1. Make	MA	Verify	Manuf acturer std.	Manuf acturer std.	Manuf acturer std.	Manufacturer approved source	Manufacturer approved source	Test Certificate/ Inspection Report	✓	P	V	V	* Sample from each armour Size/ Batch/ lot
		2. Dimension	MA	Measurement	-do-	-do-	-do-	Approved data sheet	Approved data sheet	-do-		P/ V	V	V	
		3. Physical & Electrical properties	MA	Physical & Electrical Tests	Sample*	Sample *	Sample*	-do-	-do-	-do-	✓	P/ V	V	V	
		4.Galvanizatio n Quality	MA	Galv.Tests	-do-	-do-	-do-	IS 3975	IS 3975	-do-		P/ V	V	V	

Supplier Logo	MANUFACTURING QUALITY PLAN	SPEC. NO : PE-RC-999-507-E005 Rev: 00	DATE: 15/02/2020
	CUSTOMER : TSGENCO	QP NO. : PE-V0 - 417-507-E916 Rev: 01	DATE: 02/11/2021
	PROJECT: 5 x 800 MW YADADRI TPS	PO NO.: R-31/21	DATE: 30/06/2021
	ITEM: Screened Control Cables	SYSTEM: Cable	Cat Plan –Cat-I	Page 3 of 8

SL NO.	COMPONENT /OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK			REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY 10			REMARKS
1	2	3	4	5	6			7	8	9	*	**			
					M	C	N				D	M	C	N	
1.6	PVC Compound for Sheath	**GENERAL**													
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Sample/ Batch	Sample/ Batch	IS 5831	IS 5831	Inspection report/ Test Certificate	✓	P	V	V	
		2. Electrical Properties	MA	Electrical Tests	Sample/ Batch	Sample/ Batch	Sample/ Batch	-do-	-do-	-do-	✓	P	V	V	
		3. FRLS properties (as applicable)	CR	Chemical / Environ	Sample/ Batch	Sample/ Batch	Sample/ Batch	Approved data sheet	Approved data sheet	-do-	✓	P/ V	V	V	
		SPECIFIC CHECKS													
		a) Make	MA	Verify	100%	100%	100%	Manufacturer approved source	Manufacturer approved source	COC / Test Certificate	✓	P/ V	V	V	
		b) Type/Grade	MA	-do-	-do-	-do-	-do-	Approved data sheet	Approved data sheet	-do-	✓	P/ V	V	V	
		c) Shelf life / Storage condition	MA	-do-	-do-	-do-	-do-	Compound Manufacturer Standard	Compound Manufacturer Standard	-do-	✓	P/ V	V	V	
1.7	Wooden Drum	1. Phy. & Constructional checks	MA	Visual	Manuf acturer std.	Manuf acturer std.	Manuf acturer std.	IS 10418	IS 10418	Inspection report/ Test Certificate	✓	P	V	V	
		2. Anti-termite treatment	MA	Chemical	-do-	-do-	-do-	Manufacturer std.	Manufacturer std.	COC	✓	P	V	V	
1.8	Steel Drum (if applicable)	1. Dimension	MA	Measurement	Manufa cturer std.	Manufa cturer std.	Manufa cturer std.	Approved drawing	Approved drawing	Test Certificate	✓	P	V	V	
		2. Surface finish	MA	Visual	-do-	-do-	-do-	–	Surface shall be smooth	-do-	✓	P	V	V	
2.0	IN PROCESS														
2.1	Wire Drawing & Annealing	1. Size	MA	Dimensional	Manufa cturer std.	Manufa cturer std.	Manufa cturer std.	Approved data sheet	Approved data sheet	Inspection report	✓	P	V	V	
		2. Surface finish	MA	Visual	-do-	-do-	-do-	–	Surface shall be smooth	-do-	✓	P	V	V	

Supplier Logo	MANUFACTURING QUALITY PLAN	SPEC. NO : PE-RC-999-507-E005 Rev: 00	DATE: 15/02/2020
	CUSTOMER : TSGENCO	QP NO. : PE-V0 - 417-507-E916 Rev: 01	DATE: 02/11/2021
	PROJECT: 5 x 800 MW YADADRI TPS	PO NO.: R-31/21	DATE: 30/06/2021
	ITEM: Screened Control Cables / SYSTEM: Cable	Cat Plan –Cat-I	Page 4 of 8

SL NO.	COMPONENT /OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK 6			REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY 10 **			REMARKS
1	2	3	4	5	M	C	N	7	8	9	D	M	C	N	
2.2	Tinning (Conductor or drain wire)	1. Size	MA	Dimensional	Manufacturer std.	Manufacturer std.	Manufacturer std.	Manufacturer std.	Manufacturer std.	Inspection report	✓	P	V	V	
		2. Chemical test for tinning	CR	Chemical	-do-	-do-	-do-	IS- 10810-4	IS- 8130	-do-	✓	P	V	V	
2.3	Stranding of Wires	1. No. of wires	MA	Counting	Manufacturer std.	Manufacturer std.	Manufacturer std.	Approved data sheet	Approved data sheet	-do-	✓	P	V	V	
		2. Resistance	CR	Electrical	-do-	-do-	-do-	-do-	-do-	-do-	✓	P	V	V	
		3. Sequence, lay length & Direction	MA	Visual Measurement	One sample of each size/Lot	One sample of each size/Lot	One sample of each size/Lot	Manufacturer std.	Manufacturer std.	-do-	✓	P	V	V	
		4. Surface Finish	MA	Visual	100 %	100 %	100 %	Surface shall be smooth	Surface shall be smooth	-do-	✓	P	V	V	
		5. Dimension	MA	Measurement	One sample of each size/Lot	One sample of each size/Lot	One sample of each size/Lot	Approved data sheet	Approved data sheet	-do-	✓	P	V	V	
2.4	Core Insulation (No repair submitted	1. Surface finish	MA	Visual	100%	100%	100%	Free from bulging, burnt, particles, lumps, cuts & scratches	Free from bulging, burnt, particles, lumps, cuts & scratches	Inspection report	✓	P	V	V	
		2. Insulation thickness (Min/Max)	CR	Measurement	One sample of each size/Lot	One sample of each size/Lot	One sample of each size/Lot	Approved data sheet	Approved data sheet	-do-	✓	P	V	V	
		3. Concentricity #	CR	Measurement	-do-	-do-	-do-	Manufacturer std.	Manufacturer std.	-do-	✓	P	V	V	# To be checked at starting and finish end of extruded length
		4. Dia over insulation	MA	Measurement	-do-	-do-	-do-	Approved data sheet	Approved data sheet	-do-	✓	P	V	V	

Supplier Logo	MANUFACTURING QUALITY PLAN	SPEC. NO : PE-RC-999-507-E005 Rev: 00	DATE: 15/02/2020
	CUSTOMER : TSGENCO	QP NO. : PE-V0 - 417-507-E916 Rev: 01	DATE: 02/11/2021
	PROJECT: 5 x 800 MW YADADRI TPS	PO NO.: R-31/21	DATE: 30/06/2021
	ITEM: Screened Control Cables	SYSTEM: Cable	Cat Plan –Cat-I	Page 5 of 8

SL NO.	COMPONENT /OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK			REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
1	2	3	4	5	6			7	8	9	*	**			
					M	C	N				D	M	C	N	
		5. Core identification	MA	Visual	100%	100%	100%	-do-	-do-	-do-	✓	P	V	V	
		6. T.S. & % Elongation	MA	Mechanical	100%	100%	100%	IS- 1554-I IS- 5831	IS- 1554-I IS- 5831	-do-	✓	P	V	V	
2.5	Core pairing, screening (provision of drain wire & laying)	1. Pair identification	MA	Visual	100%	100%	100%	Approved data sheet	Approved data sheet	Inspection report	✓	P	V	V	
		2. Wire size and tape size	MA	Measurement	100%	100%	100%	-do-	-do-	-do-	✓	P	V	V	
		3. Test for capacitance	CR	Electrical test	100%	100%	100%	-do-	-do-	-do-	✓	P	V	V	
		4. Sequence of lay and lay length	MA	Visual	One sample of each size/Lot	One sample of each size/Lot	One sample of each size/Lot	-do-	-do-	-do-	✓	P	V	V	
		5.Screen overlap and coverage	MA	Measurement	-do-	-do-	-do-	-do-	-do-	-do-	✓	P	V	V	
		6. Dia over laid up core	MA	Measurement	-do-	-do-	-do-	-do-	-do-	-do-	✓	P	V	V	
		7. Continuity of drain and drain wire with screen	MA	Electrical Test	100%	100%	100%	------No discontinuity------		-do-	✓	P	V	V	
2.6	Inner Sheath extrusion (as applicable)	1. Surface finish	MA	Visual	100%	100%	100%	---	Free from bulging, burnt, particles, lumps, cuts & scratches	-do-	✓	P	V	V	
		2. Thickness	CR	Measurement	One sample of each size/Lot	One sample of each size/Lot	One sample of each size/Lot	Approved data sheet	Approved data sheet	-do-	✓	P	V	V	
		3. Dia over inner sheath	MA	-do-	-do-	-do-	-do-	-do-	-do-	-do-	✓	P	V	V	

Supplier Logo	MANUFACTURING QUALITY PLAN	SPEC. NO : PE-RC-999-507-E005 Rev: 00	DATE: 15/02/2020
	CUSTOMER : TSGENCO	QP NO. : PE-V0 - 417-507-E916 Rev: 01	DATE: 02/11/2021
	PROJECT: 5 x 800 MW YADADRI TPS	PO NO.: R-31/21	DATE: 30/06/2021
	ITEM: Screened Control Cables / SYSTEM: Cable	Cat Plan –Cat-I	Page 6 of 8

SL NO.	COMPONENT /OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK			REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY **			REMARKS
1	2	3	4	5	6			7	8	9	D	M	C	N	
					M	C	N								
2.7	Armouring (as applicable)	1. No. of wires/strip	MA	Counting	At the start of process	—	—	Manufacturer std.	Manufacturer std.	Inspection report	✓	P	V	V	
		2. Size of wire / strip	MA	Measurement	-do-	—	—	Approved data sheet	Approved data sheet	-do-	✓	P	V	V	
		3. Lay direction	MA	Visual	-do-	—	—	Manufacturer std.	Manufacturer std.	-do-	✓	P	V	V	
		4. Lay length	MA	Visual & Measurement	-do-	—	—	-do-	-do-	-do-	✓	P	V	V	
		5. Coverage	MA	Measurement	-do-	—	—	Approved data sheet	Approved data sheet	-do-	✓	P	V	V	
		6. Dia over armouring	MA	Measurement	-do-	—	—	-do-	-do-	-do-	✓	P	V	V	
2.8	Outer Sheath Extrusion	1 Surface finish	MA	Visual	100%	—	—	—	Free from bulging, burnt, particles, lumps, cuts & scratches	-do-	✓	P	V	V	
		2. Sheath Thickness	CR	Measurement	One sample of each size/Lot	—	—	Approved data sheet	Approved data sheet	-do-	✓	P	V	V	
		3. Dia over outer sheath	MA	Measurement	-do-	—	—	-do-	-do-	-do-	✓	P	V	V	
		4. Marking/ colour/ Embossing	MA	Visual	100%	—	—	-do-	-do-	-do-	✓	P	V	V	Sequential marking to be done
		5. T.S. & % Elongation	MA	Mechanical	100%	—	—	IS- 5831 / IS- 10810 Part 7	IS- 5831	-do-	✓	P	V	V	
3.0	Final Inspection (INTERNAL)	1. Routine Test (Refer Note-H)	CR	Electrical Test & Measurement	100%	100%	100%	#	#	-do-	✓	P	V	V	# Refer Annexure –A to QP

Supplier Logo	MANUFACTURING QUALITY PLAN	SPEC. NO : PE-RC-999-507-E005 Rev: 00	DATE: 15/02/2020
	CUSTOMER : TSGENCO	QP NO. : PE-V0 - 417-507-E916 Rev: 01	DATE: 02/11/2021
	PROJECT: 5 x 800 MW YADADRI TPS	PO NO.: R-31/21	DATE: 30/06/2021
	ITEM: Screened Control Cables	SYSTEM: Cable	Cat Plan –Cat-I	Page 7 of 8

SL NO.	COMPONENT /OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK			REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY 10 **			REMARKS
1	2	3	4	5	6			7	8	9	*				
					M	C	N				D	M	C	N	
4.0	Final Inspection (EXTERNAL)	1. Finish & length (Cable & cable drum)	MA	Visual	One drum in Each lot	One drum in Each lot	One drum in Each lot	Approved data sheet	Free from Porosity, Bulging. Burnt particles, lumps, cuts & scratches	Inspection report	✓	P	W	W	# Refer Annexure –A to QP
		2. Dimension	MA	Measurement	As per Std.	As per Std	As per Std	Approved data sheet	Approved data sheet	-do-	✓	P	W	W	"W" at client column shall be considered as hold point
		3. Armouring - Coverage	MA	Measurement	-do-	-do-	-do-	-do-	-do-	-do-	✓	P	W	W	
		4. Marking/ Colour/ pair identification (Cable & Cable drum	MA	Visual	-do-	-do-	-do-	-do-	-do-	-do-	✓	P	W	W	
		5. Acceptance Test (Refer Note-H)	CR	Physical & Electrical Test	Sample #	Sample #	Sample #	#	-do-	-do-	✓	P	W	W	
		6. Type & FRLS Test (Refer Note-H)	CR	As per Std	Sample #	Sample #	Sample #	-do-	Approved data sheet	-do-	✓	P	W	W	
5.0	Packing	End sealing/ Polythene wrapping	MA	Visual	100%	100%	100%	Approved data sheet	Approved data sheet	-do-	✓	P	W	W	

NOTES:

A. Joints in conductors & armour shall be as permitted by IS:8130 & IS:7098 –I respectively.

B. No repair of core insulation permitted.

C. Cable end shall be sealed.

D. Record of raw material, process & all stages shall be certified by Vendors QC and are liable to audit check by purchaser.

Supplier Logo	MANUFACTURING QUALITY PLAN		SPEC. NO : PE-RC-999-507-E005 Rev: 00	DATE: 15/02/2020
	CUSTOMER : TSGENCO		QP NO. : PE-V0 - 417-507-E916 Rev: 01	DATE: 02/11/2021
	PROJECT: 5 x 800 MW YADADRI TPS		PO NO.: R-31/21	DATE: 30/06/2021
	ITEM: Screened Control Cables	SYSTEM: Cable	Cat Plan –Cat-I	Page 8 of 8

SL NO.	COMPONENT /OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK			REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY 10			REMARKS
1	2	3	4	5	6			7	8	9	*	**			
					M	C	N				D	M	C	N	

E. Fillers/dummy cores etc Shall be as per specification.

F. Wherever extent of check for stage is mentioned as 'sample' & 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 IS/ BHEL specification.

H. For list of routine tests, acceptance tests & type tests refer annexure to QAP.

I. 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.

J. 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.

K. BHEL reserves the fight to perform repeat test if required

L. Photographs of cable to be despatched shall be sent to BHEL purchase group for review prior to issue of MDCC.

M. " W " at client column shall be considered as hold point

N. All inspection/verification reports along with material certificates shall be reviewed at the time of witness point.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION, **D**: DOCUMENTATION

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, **C**: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **N**: TSGENCO/TPIA

P: PERFORM, **W**: WITNESS, **V**: VERIFICATION, AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL, **D**: DOCUMENTATION

	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER:
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R02	SPECIFICATION TITLE:
	SHEET 1 OF 4	SYSTEM: CABLE	ITEM: SCREENED CONTROL CABLES	DOC. NO.

TYPE/ ACCEPTANCE/ROUTINE TEST REQUIREMENTS

A. **Type Test Conduction:**

1. Tests for which "T" is indicated in the 'Test Conduction Required As' column below shall be conducted as Type Test.

2. Sampling:

a)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.
b) Electrical and C&I tests to be conducted on each size of each type of cables/ lot.
c) FRLS &Flammability Test to be conducted only on one sample/ lot, irrespective of size/ type.

B. **Acceptance Test Conduction:**

1. Tests for which "A" is indicated in the 'Test Conduction Required As' column below shall be conducted as Acceptance tests.

2. Sampling:
a) 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.
b) Electrical and C&I tests to be conducted on each size of each type of cables/ lot.
c) FRLS & Flammability Test to be conducted only on one sample/ lot, irrespective of size/ type.

C. **Routine Test Conduction:**

1. Tests for which "R" is indicated in the 'Test Conduction Required As' column below shall be conducted as Routine tests.
2. 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.**

Note: LOT shall be considered as per IS: 1554Part-I.

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	***In-process records shall be furnished to inspector at time of inspection.***
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	IS 10810 Pt 5	
IV.	Diameter Test	For conductor	T,A	ADS	

	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER:
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R02	SPECIFICATION TITLE:
	SHEET 2 OF 4	SYSTEM: CABLE	ITEM: SCREENED CONTROL CABLES	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
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 / Adhesion Test	For GS strip only	T, A	IS 10810 Pt 39	
VI.	Resistivity test	Applicable for Aluminium wire & GS wire	T, A	IS 10810 Pt 42	
VII.	Uniformity of Zinc coating test	For G. S. wires/Strip only	T, A	IS 10810 Pt 40	
VIII.	Mass of Zinc coating test	For G. S. wires/Strip only	T, A	IS 10810 Pt 41	
3.0	**Physical Tests for XLPE Insulation & PVC sheath**				
I.	Test for thickness and eccentricity	Applicable for PVC insulation, PVC inner sheath & PVC outer sheath	T, A	IS 10810 Pt 6	
II.	Tensile strength and elongation test at break	Applicable for PVC insulation & PVC outer sheath			
(a)	Before ageing		T, A	IS 10810 Pt 7	
(b)	After ageing		T, A	IS 10810 Pt 7	
III.	Ageing in air oven	For PVC insulation & PVC outer sheath	T	IS 10810 Pt 11	
IV.	Loss of mass in air oven test	For PVC insulation & PVC outer & inner sheath	T	IS 10810 Pt 10	
V.	Hot deformation test	For PVC insulation & PVC outer & inner sheath	T	IS 10810 Pt 15	
VI.	Heat shock test	For PVC insulation & PVC outer & inner sheath	T	IS 10810 Pt 14	
VII.	Shrinkage test	For PVC insulation & PVC outer & inner sheath	T	IS 10810 Pt 12	
VIII.	Thermal stability test	For PVC insulation & PVC outer & inner sheath	T	IS 10810 Pt 60	
IX.	Bleeding & Blooming test	For PVC insulation & PVC outer sheath	T	IS 10810 Pt 19	
X.	Cold bend test	For PVC insulation & PVC outer & inner sheath	T	IS 10810 Pt 20	
XI.	Cold impact test	For PVC insulation & PVC outer & inner sheath	T	IS 10810 Pt 21	

	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER:
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R02	SPECIFICATION TITLE:
	SHEET 3 OF 4	SYSTEM: CABLE	ITEM: SCREENED CONTROL CABLES	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
XII.	Colour fastness to water	For PVC insulation & PVC outer sheath	T	IS 10810 Pt 18, Appendix-A of IS:5831	
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	A	ADS	
5.0	**Tests for drain wire**				
VI.	Annealing test	For copper conductor only	T, A	IS 10810 Pt 1	***In-process records shall be furnished to inspector at time of inspection.***
VII.	Tin coating test (for tinned copper)	For copper conductor only	T, A	IS 10810 Pt 4	
VIII.	Resistance test	For Al/Cu	T, A, R	IS 10810 Pt 5	
IX.	Diameter Test	For conductor	T,A	ADS	
6.0	**FRLS Tests**				
I.	Oxygen index test	For PVC outer sheath & Fillers only	T, A	IS 10810 Pt 58 / ASTMD 2863	Applicable for Inner Sheath also, if the same is indicated in Datasheet-A
II.	Smoke density test	For PVC outer sheath & Fillers only	T,A	ASTMD 2843	
III.	Acid gas generation test	For PVC outer sheath & Fillers only	T, A	IS 10810 Pt 59 / IEC-754-1	
IV.	Temperature Index Test	For PVC outer sheath only	T	IS 10810 Pt 64 / ASTMD 2863	
7.0	**Flammability Tests**				
I.	Flammability test for bunched cables	For complete cable	T,A	IS 10810 Pt 62/ IEC-60332 (Part-3-23-Cat-B)	Test & Category applicable as indicated in Datasheet-A
II.	Flammability test for single cable	For complete cable	T,A	IS: 10810 Pt 61 / IEC:60332 Part-1	

	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER:
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R02	SPECIFICATION TITLE:
	SHEET 4 OF 4	SYSTEM: CABLE	ITEM: SCREENED CONTROL CABLES	DOC. NO.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
III.	Swedish chimney test	For complete cable	A	SEN SS 424 1475 (Class F3)	
IV.	Flammability test	For complete cable	A	IEEE: 60383	
8.0	Electrical Tests				
I.	High Voltage Test	For complete cable	T, A, R	IS 10810 Pt 45	
II.	Insulation Resistance Test (Volume resistivity method)	For complete cable	T, A,R	IS 10810 Pt 43	
III.	L/R Ratio	For complete cable	A,R	BS: 5308 Part-II	
IV.	Spark Test	Online process during Extrusion of Insulation	Online	BS: 5308 Part-II	
V.	Thermal Ageing test	For complete cable	T	IS 1554-Part-I	
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,R	ADS	
V.	Noise interference	For complete cable	T,A	ADS	
10.0	Anti-rodent and Termite Repulsion test	For PVC outer sheath only	A	Refer Note	Test applicable if indicated in Datasheet-A
11.0	Anti-Fungal Test	For PVC outer sheath only	A	Self-certification by vendor for anti-fungal property	Same shall be applicable as per the project requirement and Datasheet-A.
12.0	Special Tests				
I.	Hydrolytic Stability Test	For complete cable	A(**)	ASTM D 3137	Test applicable if indicated in Datasheet-A
II.	Ultraviolet Radiation Test	For complete cable	A(**)	BS EN ISO 4892-2	

***** These tests shall be conducted on one sample for the entire contract and duration of these tests shall be 14 days.***

	ANNEXURE-A TO QP	CUSTOMER:	PROJECT TITLE	SPECIFICATION NUMBER:
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R02	SPECIFICATION TITLE:
	SHEET 5 OF 4	SYSTEM: CABLE	ITEM: SCREENED CONTROL CABLES	DOC. NO.

Note: A few chipping of the PVC compound is slowly ignited on a porcelain dish or cubicle in a muffle furnace at about 600-degree C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). Place a drop of aqueous sodium sulphide solution on a thick filter paper and allow soaking. Touch the spot with a drop of above extract. A black spot indicates the presence of lead, the anti-termite and rodent compound.

TECHMICAL PQR

~~1361191/2023/PS-PEM-EL~~

BHEL	**PRE-QUALIFICATION REQUIRMENTS FOR SCREENED CONTROL CABLE YADADRI TPS 5X800MW**	PE-PQ-417-507-E016 REVISION NO. 00 DATE 11/03/2023 SHEET NO. 1 OF 1

ITEMS : Screened Control Cable **SCOPE :** Supply : YES; Erection & Commissioning : NO;	
1.0	Vendor should be a manufacturer of screened/ instrumentation control cables.
2.0	Availability of test reports of tests on FRLS screened control cables to establish in-house Capability to carry out all routine, type acceptance as per relevant IS/ International Standards (except UV radiation & hydrolytic stability Test which can be conducted at Govt. Lab/ Govt. approved Independent lab).
3.0	Capacity of manufacturing 200 km of screened control cables per month.
4.0	Manufactured and supplied at least one (1) km of FRLS cables.
5.0	Manufactured and supplied screened control cables up to 20 pairs.
6.0	Manufactured and supplied at least 800 Km of Screened Control cables in one or more orders and at least 200 Km in one single order.
7.0	Minimum two (2) nos. purchase orders for screened control cables shall be submitted which should not be more than five (5) years old from the date of techno-commercial bid opening for establishing continuity in business.

NOTES:

1. Consideration of offer shall be subject to customer's approval of bidders, if applicable.

2. Bidder to submit all supporting documents in English. If documents submitted by bidder are in language other than English, a self- attested English translated document should also be submitted.

3. Notwithstanding anything stated above, BHEL reserves the right to assess the capabilities and capacity of the bidder to perform the contract, should the circumstances warrant such assessment in the overall interest of BHEL.

4. After satisfactory fulfillment of all the above criteria/requirement, offer shall be considered for further evaluation as per NIT & all the other terms of the tender.

PREPARED BY	CHECKED BY	REVIEWED BY	APPROVED BY
11.03.23	11.03.2023	13/03/2023	26/3/23
ABHINAV BANSHIWALA MANAGER	N.N.JAJWARE SR. MANAGER	PRAVEEN DUTTA A.G.M.	DEBASISA RATH A.G.M.(DH-ELEC)

5 x 800 MW YADADRI TPS

ANNEXURE B (Main Supply)

BOQ-CUM-PRICE SCHEDULE FOR SCREENED CONTROL CABLE

S.No.	Item code	Item Description	UOM	Main Supply Quantity	UNIT EX- WORKS PRICE (DULY PACKED) (INR)	TOTAL EX-WORKS PRICE (DULY PACKED) (INR)	Freight rate in %	Freight Amount in INR	Total Ex works + Freight (INR)	GST type	GST rate in %	GST amount in INR	TOTAL F.O.R SITE PRICE (INR)
Overall Screened Cable (Type-G)													
1	507-31025-A	1.1kV TYPE G(O) 2P - 0.5 ARMOURED	MTR	2,14,000									
2	507-31029-A	1.1kV TYPE G(O) 4P - 0.5 ARMOURED	MTR	61,000									
3	507-31033-A	1.1kV TYPE G(O) 8P - 0.5 ARMOURED	MTR	3,04,000									
4	507-31017-A	1.1kV TYPE G(O) 12P - 0.5 ARMOURED	MTR	46,000									
Individual & Overall Screened Cable (Type-F)													
5	507-31009-A	1.1kV TYPE F(IO) 4P - 0.5 ARMOURED	MTR	1,09,000									
6	507-31013-A	1.1kV TYPE F(IO) 8P - 0.5 ARMOURED	MTR	13,000									
7	507-31001-A	1.1kV TYPE F(IO) 12P - 0.5 ARMOURED	MTR	4,000									
8	507-31005-A	1.1kV TYPE F(IO) 20P - 0.5 ARMOURED	MTR	67,000									

NOTES:-

1.Total Quantity indicated above shall be known as Order Quantities. The total quantity variation shall be as per NIT.

2. Standard drum length shall be as per Datasheet provided in Technical Specification. Tolerance on individual drum length shall be ±5%. For each individual cable size, one short length of not less than 200m may be accepted only in the final drum length to complete the supply. The overall tolerance limits stipulated above shall continue to apply (in case short lengths are accepted).

3. Overall tolerance on total dispatched quantity of each size shall be (-) 2% and (+) 0% except where the total ordered quantity is one single drum length, in which case it shall be -5% to 0%. Cables consumed for testing and inspection shall be to bidder's account.

4. Bidder shall indicate unit price of cables inclusive of type test charges, No separate charges shall be payable for type tests.

5. Unit Price for Mandatory Spares shall be same as that of Main supply items.

5 x 800 MW YADADRI TPS

ANNEXURE B (Mandatory Spares)

BOQ-CUM-PRICE SCHEDULE FOR SCREENED CONTROL CABLE

S.No.	Item code	Item Description	UOM	Mandatory Spares Quantity	UNIT EX- WORKS PRICE (DULY PACKED) (INR)	TOTAL EX-WORKS PRICE (DULY PACKED) (INR)	Freight rate in %	Freight Amount in INR	Total Ex works + Freight (INR)	GST type	GST rate in %	GST amount in INR	TOTAL F.O.R SITE PRICE (INR)
Overall Screened Cable (Type-G)													
1	507-31025-A	1.1kV TYPE G(O) 2P - 0.5 ARMOURED	MTR	16,000									
2	507-31029-A	1.1kV TYPE G(O) 4P - 0.5 ARMOURED	MTR	9,000									
3	507-31033-A	1.1kV TYPE G(O) 8P - 0.5 ARMOURED	MTR	27,000									
4	507-31017-A	1.1kV TYPE G(O) 12P - 0.5 ARMOURED	MTR	5,000									
Individual & Overall Screened Cable (Type-F)													
5	507-31009-A	1.1kV TYPE F(IO) 4P - 0.5 ARMOURED	MTR	13,000									
6	507-31013-A	1.1kV TYPE F(IO) 8P - 0.5 ARMOURED	MTR	6,000									
7	507-31001-A	1.1kV TYPE F(IO) 12P - 0.5 ARMOURED	MTR	1,000									
8	507-31005-A	1.1kV TYPE F(IO) 20P - 0.5 ARMOURED	MTR	4,000									

PVC Formulae & Factors document

Ref: PW/PE/CMM-PVC Cables Packages (Rev-02) **Dated:19/02/2019**

Note: Applicable for cable tenders released on or after 14/01/2019.

Price Variation Formulae for cables -Annexure-I

1. Prices shall be variable as per price variation formulae given below (basis IEEMA).
The price variation shall be limited to + 20% of total ex-works price actually supplied (cable size wise) and -ve price variation shall be unlimited. Rates for working out price variation shall be as per rates published by IEEMA for the factors given in Annexure-II

2. **Base date for prices:**

Initial Price (As per IEEMA) for-Alo, Cuo, CCo, PVCCo & Feo:
Base Date shall be- 1st working day of the previous month to the date of issue of tender enquiry.

Final Price (as per IEEMA) for- Al, Cu, Cc, PVCC & Fe:
1st working day of month, one month prior to the date on which cable is notified as being ready for inspection i.e TPIA inspection call raise date on web portal.

3. Variation factor value for ALF, CuF, CCFAL, CCFCu, XLFAL, XLFCu, FeF & FeW as applicable shall be as per Technical Specification.

4. PVC shall be payable within contractual delivery period (including any extension thereto).

IEEMA table for Price variation cause for various type of cable

1. Aluminium conductor cable

S.No	Cable Type	AlF (Single core unarmoured & Multi core armoured)	AlF (Single core armoured)	CCFAl	XLFAL (Single core)	XLFAL (Multi core)	FeF	FeW	IEEMA Formula
1.	HT XLPE Power cable	ALP	H1	H2	XL3	XL4	H3	H5	P=Po+AIF(AL-Alo) + XLFAL(CC-CCo) +CCFAl(PVCC-PVCCo) + FeF(Fe-Feo)
2.	LT XLPE Power Cable	ALP	P1	L2	XL1	XL1	P3	P3 (Additional)	P=Po+AIF(AL-Alo) + XLFAL(CC-CCo) +CCFAl(PVCC-PVCCo) + FeF(Fe-Feo)
3.	LT PVC Power Cable	ALP	P1	P2	-	-	P3	P3 (Additional)	P=Po+AIF(AL-Alo) + CCFAl(PVCC-PVCCo) + FeF(Fe-Feo)
4.	LT HRPVC Power Cable	ALP	P1	P2	-	-	P3	P3 (Additional)	P=Po+AIF(AL-Alo) + CCFAl(PVCC-PVCCo) + FeF(Fe-Feo)

2. Copper conductor cable

S no.	Cable type	CuF	AIF (single core armoured)	CCFCu	XLFCU (Single core)	XLFCU (Multi core)	FeF	FeW	IEEMA Formula
I	HT XLPE Power cable	CUP	H4	H2	XL3	XL4	H3	H5	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) +CCFCu(PVCC-PVCCo) + FeF(Fe-Feo) + AIF(AL-Alo)
2	LT XLPE Power Cable	CUP	P4	L2	XL1	XL1	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo) + AIF(AL-Alo)

S no.	Cable type	CuF	AIF (single core armoured)	CCFCu	XLFCU (Single core)	XLFCU (Multi core)	FeF	FeW	IEEMA Formula
3	LT PVC Power Cable	CUP	P4	P2	--	--	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo) + AIF(AL-Alo)
4	LT HRPVC Power Cable	CUP	P4	P2	--	--	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo) + AIF(AL-Alo)
5	LT XLPE Control Cable	CUC	--	P5	--	XL2	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
6	LT PVC Control Cable	CUC	--	P5	--	--	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
7	LT HRPVC Control Cable	CUC	--	P5	--	--	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu(PVCC-PVCCo) + FeF(Fe-Feo)
8	LT XLPE Fire Survival Power Cable	CUP	P4	L2	XL1	XL1	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo))+ AIF(AL-Alo)
9	LT XLPE Fire Survival Control	CUC	--	P5	--	XL2	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + XLFCU(CC-CCo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
10	LT EPR Fire Survival Power Cable	CUP	P4	L2	--	--	P3	P3 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo))+ AIF(AL-Alo)
11	LT EPR Fire Survival Control cable	CUC	--	P5	--	--	P6	P6 (Additional)	P=Po+CuF(Cu-Cuo) + CCFCu (PVCC-PVCCo) + FeF(Fe-Feo)
12	Screened control Cable (Overall screen)	Cu POS	--	--	--	--	Fe POS	Fe POS	P=Po+CuF(Cu-Cuo) + FeF(Fe-Feo)
13	Screened control Cable (Individual	Cu PIS	--	--	--	--	Fe PIS	Fe PIS	P=Po+CuF(Cu-Cuo) + FeF(Fe-Feo)

Annexure-II

IEEMA *Table* for Price Variation Clause for various types of Cables

Notes:-

(i) Cu POS, Cu PIS, Fe POS & Fe PIS tables shall be as per IEEMA circular No. IIEMA (PVC) /Instrumentation Cable/2014 effective from dtd 01.07.2014.

(ii) All other tables shall be as per IEEMA circular No. 35//DIV/CAB/05/ dated 24.04.2018.

Terms used in PVC formulae:

P = Price payable as adjusted in accordance with above appropriate formula (In Rs./Km).
Po= Price quoted/confined (in Rs./km).

1. ALUMINIUM
ALF Variation factor for aluminium.
Al =Price of aluminium.
Alo = Price of aluminium.

2 COPPER
CuF =Variation factor for copper.
Cu = Price of CC copper rods.
Cuo = Price of CC copper rods.

3.PVCc COMPOUND/POLYMER
PVCc = Price of PVC compound.
PVCco= Price of PVC compound.
CCFAL= Variation factor for PVC compound/Polymer for aluminium conductor cable.
CCFCu =Variation factor for PVC compound/Polymer for copper conductor cable.

4. XLPE COMPOUND
Cc = Price of XLPE compound.
Cco= Price of XLPE compound.
XLFAL= Variation factor for XLPE compound for aluminium conductor cable.
XLFCu =Variation factor for XLPE compound for copper conductor cable.

5.STEEL
Fe= Price of steel strips/steel wire.
Feo= Price of steel strips/steel wire.
FeF =Variation factor for steel.
FeW=Variation factor for round wire steel armouring.

ieema
your link to electricity

501, Kakad Chambers
132, Dr. Annie Besant Road, Worli
Mumbai 400018
India

P: +91 22 2493 0532
F: +91 22 2493 2705
E: mumbai@ieema.org
www.ieema.org

IEEMA (PVC)/Instrumentation Cable/2014 **Effective from: 1st July 2014**

Material Price Variation Clause For Instrumentation Cables

The Price quoted/confirmed is based on the input cost of raw materials/components as on the date of quotation, and the same is deemed to be related to the prices of raw materials as specified in the price variation clause given below. In case of any variation in these prices, the price payable shall be subject to adjustment up or down in accordance with the formulae provided in this document.

Terms used in price variation formulae:

P Price payable as adjusted in accordance with above appropriate formula **(in Rs/Km)**

Po Price quoted/confirmed **(in Rs/Km)**

COPPER

CuF Variation factor for copper

Cu Price of CC copper rods. This price is as applicable on first working day of the month, one month prior to the date of delivery.

Cu_o Price of CC copper rods. This price is as applicable on first working day of the month, one month prior to the date of tendering.

STEEL

FeF Variation factor for steel

Fe Price of Steel Strips/steel wire. This price is as applicable on the first working day of the month, one month prior to the date of delivery.

Fe_o Price of steel strips/steel wire. This price is as applicable on first working day of the month, one month prior to the date of tendering.

The above prices and indices are as published by IEEMA vide Circular reference IEEMA(PVC)/CABLE/--/-- prevailing as on 1st working day of the month i.e. one month prior to the date of tendering.

The date of delivery is the date on which the cable is notified as being ready for inspection/dispatch (in the absence of such notification, the date of manufacturer's dispatch note is to be considered as the date of delivery) or the contracted delivery date (including any agreed extension thereto), whichever is earlier.

New Delhi
Rishyamook Building, First Floor
85 A, Panchkuian Road
New Delhi 110001, India
P: +91 11 2336 3013/14
F: +91 11 2336 3015
E: delhi@ieema.org

Bangalore
204, Swiss Complex
33, Race Course Road
Bangalore 560001, India
P: +91 80 2220 1316/18
F: +91 80 2220 1317
E: bangalore@ieema.org

Kolkata
503 A, Oswal Chambers
2, Church Lane
Kolkata 700001, India
P: +91 33 6510 7855
F: +91 33 2213 1326
E: kolkata@ieema.org

ieema
your link to electricity

IEEMA (PVC)/Instrumentation Cable/2014 **Effective from: 1st July 2014**

Notes

(a) All prices of raw materials are exclusive of modvatable excise/CV duty amount and exclusive of any other central, state or local taxes, octroi, etc.

(b) All Prices are as on first working day of the month.

(c) The details of prices are as under:

1. Price of CC copper rods (in Rs/MT) is ex-works price as quoted by the primary producer.
2. Price of galvanized steel strip / steel wire (in Rs/MT) is ex-works price as quoted by the manufacturer for Round steel Wire and Flat steel strip (the relevant price of steel strip or steel wire is to be selected depending upon the type of armouring of the cable).

Price variation formula for 'Instrumentaion Cables'

P = Po + CuF (Cu – Cuo) + FeF (Fe – Feo)

1. **For Pair Instrumentation Over all Screen Cables**

Tables References:

Cu POS Copper Factor
Fe POS Steel Factor

2. **For Pair Instrumentation Individual and Over all Screen Cables**

Tables References:

Cu PIS Copper Factor
Fe PIS Steel Factor

3. **For Triad Instrumentation Over all Screen Cables**

Tables References:

Cu TOS Copper Factor
Fe TOS Steel Factor

4. **For Triad Instrumentation Individual & Overall Screen Cables**

Tables References:

Cu TIS Copper Factor
Fe TIS Steel Factor

Deputy Director General

Copper Factors for Instrumentation Cables - CuF

Cu POS

Pair Instrumentation Over all Screen Cables					
No. of Pairs Cable size in sq.mm	0.5 sq.mm	0.75 sq.mm	1.0 sq.mm	1.5 sq.mm	2.5 sq.mm
1	0.0142	0.0185	0.0233	0.0326	0.0500
2	0.0258	0.0345	0.0440	0.0625	0.0978
3	0.0353	0.0484	0.0626	0.0904	0.1433
4	0.0448	0.0623	0.0811	0.1183	0.1888
5	0.0578	0.0800	0.1022	0.1467	0.2356
6	0.0662	0.0926	0.1210	0.1768	0.2829
7	0.0756	0.1067	0.1378	0.2000	0.3245
8	0.0852	0.1204	0.1582	0.2327	0.3741
9	0.0933	0.1334	0.1734	0.2534	0.4134
10	0.1046	0.1485	0.1959	0.2893	0.4665
11	0.1111	0.1600	0.2089	0.3067	0.5023
12	0.1236	0.1764	0.2333	0.3452	0.5580
13	0.1289	0.1867	0.2445	0.3600	0.5912
14	0.1378	0.2000	0.2623	0.3867	0.6356
15	0.1467	0.2134	0.2800	0.4134	0.6801
16	0.1618	0.2322	0.3080	0.4573	0.7409
17	0.1645	0.2400	0.3156	0.4667	0.7690
18	0.1734	0.2534	0.3334	0.4934	0.8134
19	0.1822	0.2667	0.3512	0.5201	0.8579
20	0.1911	0.2800	0.3689	0.5467	0.9023
21	0.2000	0.2934	0.3867	0.5734	0.9468
22	0.2089	0.3067	0.4045	0.6001	0.9912
23	0.2178	0.3200	0.4223	0.6267	1.0357
24	0.2381	0.3437	0.4575	0.6813	1.1068
25	0.2356	0.3467	0.4578	0.6801	1.1246
26	0.2445	0.3600	0.4756	0.7068	1.1690
27	0.2534	0.3734	0.4934	0.7334	1.2135
28	0.2623	0.3867	0.5112	0.7601	1.2579
29	0.2711	0.4001	0.5290	0.7868	1.3024
30	0.2800	0.4134	0.5467	0.8134	1.3468
31	0.2889	0.4267	0.5645	0.8401	1.3913
32	0.2978	0.4401	0.5823	0.8668	1.4357
33	0.3067	0.4534	0.6001	0.8934	1.4802
34	0.3156	0.4667	0.6179	0.9201	1.5246
35	0.3245	0.4801	0.6356	0.9468	1.5691
36	0.3334	0.4934	0.6534	0.9735	1.6135
37	0.3423	0.5067	0.6712	1.0001	1.6580
38	0.3512	0.5201	0.6890	1.0268	1.7024
39	0.3600	0.5334	0.7068	1.0535	1.7469
40	0.3689	0.5467	0.7245	1.0801	1.7913
41	0.3778	0.5601	0.7423	1.1068	1.8358
42	0.3867	0.5734	0.7601	1.1335	1.8802
43	0.3956	0.5867	0.7779	1.1601	1.9247
44	0.4045	0.6001	0.7957	1.1868	1.9691
45	0.4134	0.6134	0.8134	1.2135	2.0136
46	0.4223	0.6267	0.8312	1.2402	2.0580
47	0.4312	0.6401	0.8490	1.2668	2.1025
48	0.4710	0.6759	0.9010	1.3410	2.2009

Copper Factors for Instrumentation Cables - CuF

Cu PIS

Pair Instrumentation Individual and Over all Screen Cables					
No. of Pairs Cable size in sq.mm	0.5 sq.mm	0.75 sq.mm	1.0 sq.mm	1.5 sq.mm	2.5 sq.mm
1	0.0133	0.0178	0.0222	0.0311	0.0489
2	0.0349	0.0437	0.0531	0.0717	0.1069
3	0.0490	0.0621	0.0763	0.1041	0.1570
4	0.0630	0.0806	0.0994	0.1389	0.2071
5	0.0800	0.1022	0.1245	0.1689	0.2578
6	0.0937	0.1200	0.1484	0.2042	0.3103
7	0.1067	0.1378	0.1689	0.2311	0.3556
8	0.1218	0.1569	0.1948	0.2692	0.4107
9	0.1334	0.1734	0.2134	0.2934	0.4534
10	0.1503	0.1943	0.2417	0.3349	0.5122
11	0.1600	0.2089	0.2578	0.3556	0.5512
12	0.1785	0.2313	0.2882	0.4001	0.6128
13	0.1867	0.2445	0.3023	0.4178	0.6490
14	0.2000	0.2623	0.3245	0.4489	0.6979
15	0.2134	0.2800	0.3467	0.4801	0.7468
16	0.2350	0.3053	0.3812	0.5305	0.8141
17	0.2400	0.3156	0.3912	0.5423	0.8446
18	0.2534	0.3334	0.4134	0.5734	0.8934
19	0.2667	0.3512	0.4356	0.6045	0.9423
20	0.2800	0.3689	0.4578	0.6356	0.9912
21	0.2934	0.3867	0.4801	0.6668	1.0401
22	0.3067	0.4045	0.5023	0.6979	1.0890
23	0.3200	0.4223	0.5245	0.7290	1.1379
24	0.3479	0.4535	0.5673	0.7911	1.2165
25	0.3467	0.4578	0.5690	0.7912	1.2357
26	0.3600	0.4756	0.5912	0.8223	1.2846
27	0.3734	0.4934	0.6134	0.8534	1.3335
28	0.3867	0.5112	0.6356	0.8846	1.3824
29	0.4001	0.5290	0.6579	0.9157	1.4313
30	0.4134	0.5467	0.6801	0.9468	1.4802
31	0.4267	0.5645	0.7023	0.9779	1.5291
32	0.4401	0.5823	0.7245	1.0090	1.5780
33	0.4534	0.6001	0.7468	1.0401	1.6269
34	0.4667	0.6179	0.7690	1.0712	1.6758
35	0.4801	0.6356	0.7912	1.1024	1.7247
36	0.4934	0.6534	0.8134	1.1335	1.7736
37	0.5067	0.6712	0.8357	1.1646	1.8225
38	0.5201	0.6890	0.8579	1.1957	1.8713
39	0.5334	0.7068	0.8801	1.2268	1.9202
40	0.5467	0.7245	0.9023	1.2579	1.9691
41	0.5601	0.7423	0.9246	1.2891	2.0180
42	0.5734	0.7601	0.9468	1.3202	2.0669
43	0.5867	0.7779	0.9690	1.3513	2.1158
44	0.6001	0.7957	0.9912	1.3824	2.1647
45	0.6134	0.8134	1.0135	1.4135	2.2136
46	0.6267	0.8312	1.0357	1.4446	2.2625
47	0.6401	0.8490	1.0579	1.4757	2.3114
48	0.6887	0.8936	1.1186	1.5587	2.4186

Steel Factors for Instrumentation Cables - FeF					
Fe POS					
Pair Instrumentation Over all Screen Cables					
No. of Pairs Cable size in sq.mm	0.5 sq.mm	0.75 sq.mm	1.0 sq.mm	1.5 sq.mm	2.5 sq.mm
1	0.1490	0.1565	0.1635	0.1735	0.1930
2	0.2190	0.2335	0.2470	0.2665	0.2595
3	0.2360	0.2545	0.2690	0.2900	0.2680
4	0.2390	0.2580	0.2715	0.2945	0.2830
5	0.2630	0.2820	0.2420	0.2805	0.3155
6	0.2840	0.3160	0.2805	0.2995	0.3430
7	0.2840	0.2595	0.2805	0.2995	0.3430
8	0.3235	0.2930	0.3030	0.3315	0.3780
9	0.2805	0.3180	0.3290	0.3590	0.4205
10	0.2970	0.3215	0.3455	0.3755	0.4385
11	0.3005	0.3255	0.3490	0.3805	0.4435
12	0.3055	0.3440	0.3680	0.3880	0.4520
13	0.3265	0.3530	0.3780	0.4105	0.4785
14	0.3265	0.3530	0.3780	0.4105	0.4785
15	0.3490	0.3765	0.4015	0.4365	0.5195
16	0.3490	0.3765	0.4015	0.4365	0.5195
17	0.3590	0.4005	0.4140	0.4635	0.5470
18	0.3590	0.4005	0.4265	0.4635	0.5470
19	0.3590	0.4005	0.4265	0.4635	0.5470
20	0.3830	0.4240	0.4535	0.4920	0.5760
21	0.3830	0.4240	0.4535	0.4920	0.5760
22	0.4065	0.4520	0.4785	0.5310	0.6190
23	0.4065	0.4520	0.4810	0.5310	0.6190
24	0.4305	0.4770	0.5070	0.5595	0.6475
25	0.4305	0.4770	0.5070	0.5595	0.6475
26	0.4305	0.4770	0.5070	0.5595	0.6475
27	0.4355	0.4820	0.5245	0.5660	0.6700
28	0.4570	0.5045	0.5345	0.5895	0.6950
29	0.4570	0.5045	0.5345	0.5895	0.6950
30	0.4570	0.5045	0.5345	0.5895	0.6950
31	0.4795	0.5285	0.5595	0.6150	0.7225
32	0.4820	0.5285	0.5595	0.6150	0.7225
33	0.4820	0.5285	0.5595	0.6150	0.7225
34	0.4920	0.5520	0.5835	0.6410	0.7500
35	0.4920	0.5520	0.5835	0.6410	0.7500
36	0.4920	0.5520	0.5835	0.6410	0.7500
37	0.4920	0.5520	0.5835	0.6410	0.7500
38	0.5145	0.5760	0.6225	0.6550	0.7805
39	0.5145	0.5760	0.6225	0.6550	0.7805
40	0.5145	0.5760	0.6225	0.6550	0.7805
41	0.5395	0.6025	0.6475	0.6975	0.8230
42	0.5395	0.6025	0.6475	0.6975	0.8230
43	0.5395	0.6025	0.6475	0.6975	0.8230
44	0.5635	0.6265	0.6735	0.7250	0.8540
45	0.5635	0.6265	0.6760	0.7250	0.8540
46	0.5635	0.6265	0.6760	0.7250	0.8540
47	0.5635	0.6265	0.6760	0.7250	0.8540
48	0.5635	0.6265	0.6760	0.7375	0.8665

Steel Factors for Instrumentation Cables - FeF

Fe PIS

Pair Instrumentation Individual and Over all Screen Cables

No. of Pairs Cable size in sq.mm	0.5 sq.mm	0.75 sq.mm	1.0 sq.mm	1.5 sq.mm	2.5 sq.mm
1	0.1880	0.1980	0.2070	0.2220	0.2410
2	0.2315	0.2460	0.2595	0.2815	0.2755
3	0.2505	0.2690	0.2820	0.2495	0.2830
4	0.2645	0.2830	0.2420	0.2805	0.3155
5	0.2895	0.2730	0.2805	0.3005	0.3430
6	0.2755	0.2980	0.3005	0.3280	0.3730
7	0.2755	0.2980	0.3005	0.3280	0.3730
8	0.2980	0.3215	0.3455	0.3740	0.4230
9	0.3230	0.3490	0.3730	0.4040	0.4685
10	0.3405	0.3655	0.3765	0.4215	0.4885
11	0.3430	0.3690	0.3815	0.4265	0.4945
12	0.3490	0.3765	0.4015	0.4470	0.5160
13	0.3715	0.3990	0.4255	0.4720	0.5420
14	0.3715	0.3990	0.4255	0.4720	0.5420
15	0.3955	0.4240	0.4510	0.5020	0.5720
16	0.3955	0.4240	0.4510	0.5020	0.5720
17	0.4190	0.4495	0.4795	0.5295	0.6150
18	0.4190	0.4495	0.4795	0.5295	0.6150
19	0.4190	0.4495	0.4795	0.5295	0.6150
20	0.4445	0.4770	0.5060	0.5570	0.6450
21	0.4445	0.4895	0.5060	0.5695	0.6450
22	0.4695	0.5045	0.5345	0.5870	0.6885
23	0.4695	0.5045	0.5345	0.5870	0.6885
24	0.4970	0.5310	0.5620	0.6285	0.7210
25	0.4970	0.5310	0.5620	0.6285	0.7210
26	0.4970	0.5310	0.5620	0.6285	0.7210
27	0.5035	0.5495	0.5810	0.6360	0.7410
28	0.5135	0.5610	0.6050	0.6610	0.7690
29	0.5135	0.5610	0.6050	0.6610	0.7690
30	0.5260	0.5610	0.6050	0.6610	0.7690
31	0.5495	0.5845	0.6300	0.6885	0.7990
32	0.5495	0.5845	0.6300	0.6885	0.7990
33	0.5495	0.5845	0.6300	0.6885	0.7990
34	0.5735	0.6225	0.6585	0.7285	0.8405
35	0.5735	0.6225	0.6585	0.7285	0.8405
36	0.5735	0.6225	0.6585	0.7285	0.8405
37	0.5735	0.6225	0.6585	0.7285	0.8405
38	0.5990	0.6485	0.6850	0.7575	0.8740
39	0.5990	0.6485	0.6850	0.7575	0.8740
40	0.5990	0.6485	0.6850	0.7575	0.8740
41	0.6250	0.6775	0.7135	0.7880	0.9180
42	0.6250	0.6775	0.7135	0.7880	0.9180
43	0.6250	0.6775	0.7135	0.7880	0.9180
44	0.6485	0.7050	0.7410	0.8165	0.9495
45	0.6485	0.7050	0.7410	0.8165	0.9495
46	0.6485	0.7050	0.7410	0.8165	0.9495
47	0.6485	0.7050	0.7410	0.8165	0.9495
48	0.6485	0.7050	0.7535	0.8290	0.9620