BHEL- ISG, BANGALORE	5X800 MW Yadadri TPS Technical Specification for EPR INSULATED FIRE SURVIVAL CABLE	Document No: IS-1-15-2001/078
	Customer : Telangana State Power Generation Corporation Ltd. (TSGENCO)	Rev. no.: 0 Dtd: 19.04.23

TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL CABLE FOR 5X800MW YADADRI TPS – COAL & ASH HANDLING SYSTEM

Important instructions to be followed by bidder:

- No technical submittal such as copies of type test certificates, technical literature, etc. is required during tender stage. Any such submission, even if made, **shall not be considered as part of offer.**
- 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.
- Kindly note that supplier shall not be allowed to revise price bid, if there is no change in technical specifications / quantity from BHEL.

BIDDER'S STAMP & SIGNATURE

Prepared By	Checked by	Approved by
Nitin Bihani (Manager)	Venkateshwara Rao V (Manager)	R K Majhi (Sr. Manager)

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SECTION-I
GENERAL SITE INFORMATION

Present proposal is for setting up 5 x 800 MW Yadadri Thermal Power Station, for Telangana State Power Generation Corporation Ltd. with all the facilities for CHP/AHP. Site is located near Verulapalem village, Damarcherla Mandal, Nalgonda District, Telangana. Basic wind speed as 44m/sec & Seismic zone-3. Climatological table for the region as enclosed in Annexure-1 shall be used for reference.

All LT Power Cables shall be suitable for operating satisfactorily in humid and dusty (coal & ash) atmosphere found in Thermal Power plants.

POWER SUPPLY SYSTEM			
1.1	HT power supply		
	i	Voltage	11kV and 3.3 kV AC
	ii	Voltage variation	±10%
	iii	Frequency variation	+3% to - 5%
	iv	Fault level	40kA RMS for 1 second
	v	Earthing	Neutral grounded through resistance
1.2	LT power supply		
	i	Voltage	415V, 3-Ph, 4 wire
	ii	Voltage variation	±10%
	iii	Frequency variation	+3% to - 5%
	iv	Combined Voltage & Frequency Variation	10% (absolute sum)
	v	Fault level	50kA RMS, for 1 second Symmetrical
	vi	Earthing	Solidly Grounded
1.3	Auxiliary AC Supply for field instruments, solenoid valves, service supply (heater/ lamp/ socket)		
	i	Voltage	1Ph, 50Hz 240VAC
	ii	Voltage variation	±10%
	iii	Frequency variation	+3% to - 5%
	iv	Fault level	50kA RMS
	v	Earthing	Effectively grounded
1.4	Control Supply		
	i	LT Switchboard	110V AC, 1 Ph 50 Hz
	ii	Circuit breakers	220 V DC +10% to (-) 15%, two wire, ungrounded
	iii	Local starter/control panel	240V AC, 1 Ph 50 Hz
1.5	Uninterrupted power supply		240V, 1-Ph, 50Hz
	UPS is envisaged for the following systems only (pertaining to coal and ash handling systems)		
	i. DCS ii. HMIs iii. PLCs		iv. RIOs v. Vibration Monitoring Panels vi. Bunker level monitoring system

For the purpose of design an ambient temperature of 50 deg. C, ground temperature of 30 deg. C, depth of laying of cables buried in ground 90cm, thermal resistivity of soil as 150 deg. c cm/W and relative humidity of 85% shall be considered.

SECTION-II
SPECIFIC TECHNICAL REQUIREMENTS

1.0 SCOPE OF ENQUIRY

- Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of EPR INSULATED FIRE SURVIVAL CABLES conforming to this specification.
- 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.
- The documents shall be in English Language and MKS (metre-kilogram-second) system of units.

2.0 BILL OF QUANTITIES

- Quantity requirements shall be as per 'BOQ (Annexure-4)' as part of NIT.
- Cables consumed for testing and inspection shall be to bidder's account.
- Standard drum length shall be as per BOQ (Annexure-4) against each size of cable. 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).
- Overall tolerance on total dispatched quantity of each size shall be (-) 2% and (+) 0%.

3.0 SPECIFIC TECHNICAL REQUIREMENTS

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

4.0. DRAWINGS & DOCUMENTS TO BE SUBMITTED

4.1 Documents/drawings to be submitted as part of technical offer & after placement of order for BHEL & customer's approval shall be as part of NIT.

4.2 Following documents/drawings shall be submitted after placement of order for approval:

Sl. No.	Drawings/Document Description
1.	Technical Data sheet – EPR Insulated Fire Survival Cable
2.	Cross-sectional Drgs.- EPR Insulated Fire Survival Cable
3.	Quality Plan - EPR Insulated Fire Survival Cable
4.	Type Test Reports for Tests conducted for this contract

Note:

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

4.3 All drawings/ documents indicated above shall be submitted through Document Management System (DMS).

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DATASHEET-A

1.0	Type of Cable	EPR INSULATED FIRE SURVIVAL CABLES
2.0	Standard applicable in general(Latest amendment to be referred if any)	IS-9968(PART-1) in general, IS-6380, IS -10810,IS 10418, IS-3975, ASTMD:2843, ASTMD-2863, IEC-60754-1, IEC-60331-1, IEC-60332-3-22, IE-:60332-3-23, IEEE-60383,SS-424-1475
3.0	Voltage Grade	1.1 KV
4.0	Number of cores, cross sectional area of conductors and quantities	As per BOQ-Cum-Price Schedule
5.0	CONDUCTOR	
(a)	Material	Copper
	Grade and Class	Stranded, Tinned annealed high conductivity, Class 2
(b)	Standard Applicable	IS - 8130
(c)	Shape	*As per IS-9968* (Part-1)
(d)	Min. number and diameter of strands for main and neutral conductor.	As per class -2 of IS 8130
(e)	Fire Barrier tape (separator tape)	Glass Mica tape in two layers with minimum 50% overlap with thickness of 0.06 mm (min.)
6.0	INSULATION	
(a)	Material	Heat resistant Elastomer compound , type IE2
(b)	Standard Applicable	IS : 9968(Part-1),IS -6380
(c)	Continuous withstand temperature	90°C
(d)	Short-circuit withstand temperature	250°C
(e)	Method of application	By extrusion; sleeve extrusion not permitted.
(f)	Method of curing	Dry/Steam/Gas/Sioplas
(g)	Nominal Thickness of insulation	As per IS : 9968(Part-1)
(h)	Fire proof tape	As per IS : 9968(Part-1)
1.	Applicable	*[√]YES [ ]NO*
7.0	CORE IDENTIFICATION	Colour coding as per IS : 9968(Part-1)
8.0	INNER SHEATH	
(a)	Material	Heat resistant, oil resistant , flame retardant (HOFR) Elastomer compound
(b)	Grade and type	Extruded Type SE-3 of IS -6380
(c)	Standard Applicable	IS : 9968(Part-1)
9.0	ARMOUR	
(a)	Material:	
(i)	Single core cables	Aluminium round wire armour.
(ii)	Multi-core cables	Single layer Round Galvanised Steel wire for multi core cable
(b)	Standard Applicable	IS-3975
(c)	Gap between armour wires	Shall not exceed one armour wire space

		(No cross-over/ over-riding)
(d)	Breaking load of joint	95 % of normal armour
10.0	OUTERSHEATH	
(a)	Material	Heat resistant, oil resistant , flame retardant (HOFR) Elastomer compound
(b)	Grade and type	Extruded Type SE-3 of IS -6380
(c)	Colour	Other than Black
(d)	Standard Applicable	IS : 9968(Part-1)
(e)	Marking	Cable size (cross section area and no. of cores) and voltage grade @ 5M (by embossing) *Word "EPR-IE2 Insulation", "FS" etc. @ 5m (by embossing)* Manufacturer's name and/ or trade name, IS No. and year of manufacture @ 5M (by embossing) 'TSGENCO' @ 5M (by printing) Progressive sequential marking @ 1m (by printing)
11.0	HOFR CHARACTERISTICS	
(a)	Oxygen index	≥30 (as per ASTMD 2863)
(b)	Temperature Index	≥350. C (as per ASTMD-2863)
(c)	Acid gas generation	<=0.5% by weight (as per IEC-60754-1)
(d)	Smoke density rating	≤ 20% (As per ASTMD 2843)
(e)	Water absorption test	As per IS -6380
(e)	Flammability Test	
(i)	*Flammability test for single cable*	*As per:* *IEC-60332 Part-1* Or *IS-10810-61*
(ii)	*Flammability test for bunched cables*	*As per:* *IEC-60332 Part-3* *CAT-A* *Or,* *IS-10810-62*
(iii)	*Flammability test for complete cable*	*As per:* *IEEE-60383* *Or,* *IS-10810-53*
(iv)	*Swedish Chimney test*	*As per SEN-SS-424-1475-F3*
(f)	*Fire survival test*	*As per IEC -60331 min 750 for 3 Hrs*
12.0	*Anti-rodent and Termite repulsion Test*	*[√]YES [ ]NO*
		The test shall be carried out to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of the PVC compound are slowly ignited in a porcelain dish or crucible in a muffle furnace at about 600°C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is

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		allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti-termite & rodent compound
13.0	Special Tests	
(a)	*UV Radiation Test as per BS EN ISO 4892-2 (Duration:- 14 days)*	*[ ]YES [√]NO*
14.0	CABLE DRUMS	
(a)	General	Cable shall be wound and packed on drums in such a manner that it will be properly sealed and firmly secured to the drum. The ends of each length shall be sealed with heat shrinkable end caps before shipment
(b)	Type of Drum	Wooden as per IS 10418
(c)	Standard drum length	As specified in BOQ-Cum-Price Schedule
(d)	Painting	Entire surface to be painted
(e)	Outermost Layer	To be covered with waterproof polyethylene
	Particular information on Drum	The cable drums shall be of heavy construction and should carry the following details in printed form: ▪ TSGENCO ▪ Manufacturer's name or trade make ▪ Type of cable & voltage grade ▪ Year of manufacture ▪ Type of insulation e.g. EPR-IE2 ▪ No. of core and size of cables ▪ Cable code e.g. FS ▪ Length of cable on drum ▪ No. of length on drum ▪ Direction of rotation, by arrow ▪ Approx. gross mass. ▪ IS/IEC number and ISI mark
15.0	SEA WORTHY PACKING	*[ ]YES [√] NO*

SECTION-III
STANDARD TECHNICAL SPECIFICATION

1.0 CODES AND STANDARDS

- 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.
- The design, material, construction, manufacture, inspection, testing and performance of EPR INSULATED FIRE SURVIVAL CABLES shall conform to the latest revision of relevant standards and codes of practices mentioned in Data Sheet – A.
- In case of conflict between the applicable reference standard and this specification, this specification shall govern.

2.0 TECHNICAL REQUIREMENTS

Technical requirements for EPR INSULATED FIRE SURVIVAL CABLES shall be as indicated in this section, in addition to those specified in Section II & Datasheet-A

3.0 QUALITY ASSURANCE, TESTING & INSPECTION

- Bidder shall confirm compliance with the BHEL Standard QAP as attached in Annexure-2 with the specification without any deviations. At contract stage, the successful bidder shall submit the same Standard QAP for BHEL/customer's approval. In case bidder has reference QAP agreed with ultimate customer, same can be submitted after award of contract for BHEL/ultimate customer's approval. There shall be no commercial implication to BHEL on account of minor changes in QAP during contract stage.
- All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved quality plan.
- Type testing, routine / acceptance testing and special testing requirements shall be as per Annexure-A to Standard QAP attached (Annexure-2). 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).
- 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).
- Cost of cables consumed for testing shall be to bidder's account.

- In case of the quantities cleared by BHEL for manufacturing are manufactured and offered for inspection by successful bidder in more than one batch, BHEL reserves the right to witness type testing on all batches without any price implications.

4.0 PACKING

- Cables shall be supplied in non-returnable drums. Material of cable drums shall be wooden.
- For wooden drums, all wooden parts shall be manufactured from seasoned wood treated by immersing in copper-nitrate solution 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 I0418. 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.
- Each drum shall carry manufacturer's name, purchaser's name, address and contract no., item no. & type, size & 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.

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SECTION-IV

TECHNICAL DOCUMENTATION

The following documentation shall be supplied to BHEL at different stages of the Project.

SL. NO.	TYPE OF DOCUMENTS	HARDCOPY DRG. / DOC nos.	For Approval within one week of LOI	STATUS	FINAL SUBMISSION
1	QAP , datasheet, catalogues, installation details	16 sets	1 Week	For Approval	
2	Type test certificates	8 sets	2 Week	For Approval	
3	Routine Test Certificate	8 sets			Along with dispatch documents
4	Storage, erection, operation & maintenance and safety instructions	8 sets		For Information	With dispatch documents
5	Catalogs, Final type and routine test certificates	8 sets		Final documentation	Along with dispatch documents
6	As built drawings for items mentioned in 1	16 sets		Final documentation	Within 1 week from final inspection and acceptance

NOTE:

1. Test Certificates shall be strictly in A3/ A4 size.
2. Test certificates shall have all the information as per IS
3. Test Certificates shall be marked “Certified” and shall be signed by competent authority from supplier side.

4 All documents shall show the following particulars: -

Name of the customer :
Project title :
Equipment name :
Suppliers reference number :
Document Number :
Revision Number :

Information to be furnished along with the offer

The following information / documents shall be specifically submitted by the bidder along with the bid in addition to the other information as called for in various sections of this specification:

i. Signed copy of this technical specification and all annexures.

ii. Unpriced Price Bid enclosed in NIT shall be duly filled as “QUOTED” against each item with signature and stamp by the bidder. The unpriced bid shall be submitted along with the offer without which the offer is liable for rejection.

iii. Deviation from the technical specification is not allowed. Clarifications required for bid preparation may be sought before bid submission.

iv. 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.

v. Any changes made by the bidder in the price schedule with respect to the cable description quantities, notes etc. from those given in relevant documents shall not be considered (i.e., technical description, quantities, notes etc. as per specification shall prevail).

vi. No technical submittal such as copies of type test certificates, data Sheets, write-up, drawing, technical literature, etc. is required during tender stage. Any such submission, even if made, shall not be considered as part of offer.

Annexure-1
CLIMATOLOGICAL DATA

BACK

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : नलगोंदा
STATION : Nalgonda

अक्षांश LAT. 17°03' देशांतर LONG. 79°16'

समुद्री तल माध्य से ऊंचाई HEIGHT ABOVE M.S.L. 227 मीटर METRES

प्रक्षणों पर आधारित BASED ON OBSERVATIONS 1975-2000

माह / MONTH		स्टेशन का सतह दाब / STATION LEVEL PRESSURE	वायु तापमान / AIR TEMPERATURE										आर्द्रता / HUMIDITY		मेघ की मात्रा / CLOUD AMOUNTS		वर्षा / RAINFALL						
			माध्य / MEAN						चरम / EXTREMES														
			शुष्क बल्ब DRY BULB	नम बल्ब WET BULB	दैनिक अधिक तम DAILY MAX	दैनिक न्यून तम DAILY MIN	माह में उच्चतम HIGHEST IN THE MONTH	माह में निम्नतम LOWEST IN THE MONTH	उच्चतम HIGHEST	दिनांक और वर्ष DATE AND YEAR	निम्नतम LOWEST	दिनांक और वर्ष DATE AND YEAR	सापेक्ष आर्द्रता RELATIVE HUMIDITY	वाष्प दाब VAPOUR PRESSURE	समस्त मेघ ALL CLOUDS	निम्न मेघ LOW CLOUDS	मासिक योग MONTHLY TOTAL	वर्षा के दिनोंकी संख्या NO. OF RAINY DAYS	वर्षसहित सबसे नम महीने का योग TOTAL IN WETTEST MONTH WITH YEAR	वर्षसहित शुष्कतम महीने का योग TOTAL IN DRIEST MONTH WITH YEAR	24 घंटोंकी सबसे भारी वर्षा HEAVIEST FALL IN 24 HOURS	दिनांक और वर्ष DATE AND YEAR	माध्य पवन गति MEAN WIND SPEED
		एच.पी.ए hPa	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C		डि. से °C		प्रतिशत %	एच.पी.ए hPa	आकाश के अष्ठमाश Oktas of sky		मि.मि. mm		मि.मि. mm	मि.मि. mm	मि.मि. mm		कि.मी. प्र. घं. Kmph
जनवरी JAN	I	989.9	21.3	19.3	30.8	18.4	33.8	16.1	36.0	17 1998	14.4	7 1992	82	21.2	2.0	1.8	13.5	0.4	155.7 1978	0.0	55.4	11 1978	
	II																						
फरवरी FEB	I	988.0	23.6	21.5	33.5	20.7	36.5	18.0	39.0	26 1980	15.4	5 1988	82	24.1	3.0	2.5	7.2	0.5	14.0 1999	0.0	49.2	20 2000	
	II																						
मार्च MAR	I	985.8	26.2	23.7	37.3	22.8	40.9	19.9	42.0	14 1983			80	27.4	1.7	1.4	6.5	0.4	88.5 1981	0.0	43.6	13 1981	
	II																						
अप्रैल APR	I	983.6	29.2	25.5	39.6	25.5	43.0	22.4	44.5	30 1991	14.6	15 1987	73	29.7	2.1	2.0	17.6	1.0	65.6 1981	0.0	40.6	24 1981	
	II																						
मई MAY	I	980.8	31.9	26.3	41.2	28.2	44.8	23.5	46.1	26 1984			63	29.7	2.7	2.5	27.0	1.4	94.3 1991	0.0	49.0	5 1981	
	II																						
जून JUN	I	978.2	29.8	25.7	37.6	27.2	42.6	23.4	46.3	2 1998	21.8	12 1991	71	29.9	5.1	4.4	65.9	3.5	48.2 2000	0.0	81.7	12 1991	
	II																						
जुलाई JUL	I	978.8	27.7	24.7	33.9	25.5	37.3	23.2	39.2	7 1992	22.0	2 1992	77	28.6	6.3	5.8	124.6	6.0	176.7 1977	36.8 1979	99.2	24 1977	
	II																						
अगस्त AUG	I	979.6	27.1	24.3	32.8	25.0	35.4	22.8	37.5	25 1979	22.0	2 1981	78	28.2	6.1	6.0	133.0	6.7	189.0 1998	33.2 1979	88.2	14 1977	
	II																						
सितम्बर SEP	I	982.0	27.4	24.4	33.6	24.9	36.4	22.8	38.5	23 1987	21.6	8 1989	77	28.3	4.9	4.2	145.5	5.8	393.1 1991	20.3 1984	152.2	21 1991	
	II																						
अक्तूबर OCT	I	985.3	26.6	23.8	33.1	23.7	36.2	21.4	36.5	1 1987	19.2	28 1980	78	27.2	4.0	3.7	104.3	3.8	333.1 1981	4.2 1984	109.2	6 1987	
	II																						
नवम्बर NOV	I	987.9	24.2	21.0	31.1	21.2	33.5	17.9	35.5	7 1996	14.6	27 1981	75	22.6	3.2	2.6	48.1	2.8	66.8 1991	1.1 1981	163.5	4 1987	
	II																						
दिसम्बर DEC	I	990.3	21.7	18.6	30.0	18.6	32.2	15.7			12.6	16 1993	73	19.4	2.7	2.3	3.8	0.3	3.1 1987	0.0	3.1	10 1987	
	II																						
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I	983.9	26.7	23.4	34.8	23.7	44.3	15.9	46.3	2	12.6	16	75	26.6	3.7	3.2	696.8	32.5	631.7	631.7	163.5	4	
	II								6	1998	12	1993							1982	1982	11	1987	
वर्षोंकी सं NUMBER OF YEARS	I	19	19	19	19	19	21	22	19		19		19	19	18	17	20	20	16	16	23		
	II																						

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : नलगोंदा
STAION : Nalgonda

माह / MONTH	मौसम परिघटना के साथ दिनों की संख्या — WEATHER PHENOMENA No. OF DAYS WITH: वर्षण 0.3 मि.मि.या अधिक PFT 0.3 mm Or more	ओले HAIL	गर्जन THUNDER	कुहरा FOG	धूल भरी आंधी DUST STORM	चंड वात SQU ALL
जनवरी JAN	0.5	0.0	0.0	0.0	0.0	0.0
फरवरी FEB	0.6	0.0	0.0	0.0	0.0	0.0
मार्च MAR	0.7	0.0	0.1	0.0	0.0	0.0
अप्रैल APR	1.1	0.0	0.0	0.0	0.0	0.0
मई MAY	1.8	0.0	0.0	0.0	0.0	0.0
जून JUN	4.5	0.0	0.0	0.0	0.0	0.0
जुलाई JUL	7.1	0.0	0.1	0.0	0.0	0.0
अगस्त AUG	7.7	0.0	0.0	0.0	0.0	0.0
सितम्बर SEP	6.6	0.0	0.0	0.0	0.0	0.0
अक्तूबर OCT	3.9	0.0	0.0	0.0	0.0	0.0
नवम्बर NOV	3.3	0.0	0.0	0.0	0.0	0.0
दिसम्बर DEC	0.4	0.0	0.0	0.0	0.0	0.0
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	33.3	0.0	0.1	0.0	0.0	0.0
वर्षों की सं NUMBER OF YEARS	22					

माह / MONTH	पवन — पवन की गती के साथ दिनों की संख्या (कि. मी. प्र. घं.) — No. OF DAYS WITH WIND SPEED (Km. p. h.): 62 या अधिक 52 Or more	20-61 20-61	1-19 1-19	0 0
जनवरी JAN	0	0	29	2
	0	0	31	0
फरवरी FEB	0	0	28	0
	0	0	28	0
मार्च MAR	0	1	30	0
	0	1	30	0
अप्रैल APR	0	0	29	1
	0	0	30	0
मई MAY	0	0	31	0
	0	0	31	0
जून JUN	0	1	29	0
	0	1	29	0
जुलाई JUL	0	1	30	0
	0	0	31	0
अगस्त AUG	0	1	30	0
	0	0	31	0
सितम्बर SEP	0	0	29	1
	0	0	29	1
अक्तूबर OCT	0	0	29	2
	0	0	30	1
नवम्बर NOV	0	0	26	4
	0	0	28	2
दिसम्बर DEC	0	0	29	2
	0	0	30	1
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	1	5	346	13
	1	3	355	6
वर्षों की सं NUMBER OF YEARS	22			

माह / MONTH	पवन — पवन की दिशा के दिनों की संख्या का प्रतिशत — PERCENTAGE No. OF DAYS WIND FROM: उ N	उपू NE	पू E	दपू SE	द S	दप SW	प W	उप NW	शांत CALM
जनवरी JAN	0	30	3	39	3	4	0	11	10
	0	29	10	51	3	1	0	4	2
फरवरी FEB	1	26	1	55	3	5	0	7	2
	1	19	7	64	3	2	0	2	2
मार्च MAR	1	25	1	55	3	5	0	9	1
	2	12	5	69	1	4	0	5	2
अप्रैल APR	0	20	1	46	4	18	0	8	3
	1	11	2	65	3	8	0	8	2
मई MAY	1	14	0	27	3	21	3	30	1
	1	20	2	29	2	19	2	24	1
जून JUN	1	2	0	6	0	36	8	47	0
	2	5	0	7	0	43	6	35	2
जुलाई JUL	1	1	0	1	0	43	10	44	0
	0	3	0	3	0	40	9	43	2
अगस्त AUG	1	1	0	2	0	32	8	55	1
	2	4	0	2	0	26	8	57	1
सितम्बर SEP	1	6	0	11	1	29	4	42	6
	4	17	1	10	0	25	6	31	6
अक्तूबर OCT	1	29	4	16	1	15	2	23	9
	2	37	6	26	1	7	2	12	7
नवम्बर NOV	3	33	7	18	2	4	0	19	14
	2	38	11	24	2	6	1	8	8
दिसम्बर DEC	3	46	3	22	1	2	1	14	8
	1	55	7	28	1	1	0	3	4
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	1	19	2	24	2	18	3	26	5
	1	21	4	33	1	15	3	19	3
वर्षों की सं NUMBER OF YEARS	22								

माह / MONTH	मेघ — मेघ मात्रा (सभी मेघ) सहित दिनों की संख्या - अष्ठमांश — No. OF DAYS WITH CLOUD AMOUNT (ALL CLOUDS) OKTAS: 0	ले-2 T-2	3-5	6-7	8
जनवरी JAN	25	0	2	1	3
	25	2	3	0	1
फरवरी FEB	18	1	3	2	4
	22	1	4	1	0
मार्च MAR	23	2	3	1	2
	26	1	2	1	1
अप्रैल APR	20	2	4	2	2
	21	1	5	2	1
मई MAY	19	2	5	2	3
	6	2	18	3	2
जून JUN	5	1	5	4	15
	2	1	4	4	19
जुलाई JUL	2	1	3	5	20
	1	0	3	4	23
अगस्त AUG	2	1	5	3	20
	0	0	1	2	28
सितम्बर SEP	4	1	6	4	15
	1	0	2	3	24
अक्तूबर OCT	18	1	5	2	5
	22	1	3	2	3
नवम्बर NOV	16	1	4	3	6
	20	1	3	2	4
दिसम्बर DEC	21	1	4	1	4
	23	2	3	1	2
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	205	13	48	29	70
	238	14	39	26	48
वर्षों की सं NUMBER OF YEARS	21				

माह / MONTH	मेघ — निम्न स्तरी मेघ मात्रा सहित दिनों की संख्या - अष्ठमांश — No. OF DAYS WITH LOW CLOUD AMOUNT OKTAS: 0	ले-2 T-2	3-5	6-7	8	कुहरा FOG 8
जनवरी JAN	25	0	2	1	3	0
	27	1	2	0	1	0
फरवरी FEB	21	1	2	1	3	0
	24	1	3	0	0	0
मार्च MAR	25	1	3	1	1	0
	27	1	2	1	0	0
अप्रैल APR	21	1	4	2	2	0
	22	1	4	2	1	0
मई MAY	21	2	4	1	3	0
	20	2	5	2	2	0
जून JUN	7	1	4	3	15	0
	3	1	5	4	17	0
जुलाई JUL	4	1	2	3	21	0
	1	1	3	4	22	0
अगस्त AUG	3	1	4	2	21	0
	1	0	1	2	27	0
सितम्बर SEP	5	1	4	3	17	0
	2	0	2	2	24	0
अक्तूबर OCT	21	0	3	2	5	0
	23	1	3	1	3	0
नवम्बर NOV	21	1	2	2	4	0
	22	1	2	2	3	0
दिसम्बर DEC	23	1	3	1	3	0
	24	2	2	1	2	0
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	238	11	37	22	57	0
	257	14	34	20	40	0
वर्षों की सं NUMBER OF YEARS	21					

माह / MONTH	दृश्यता — दृश्यता सहित दिनों की संख्या — No. OF DAYS WITH VISIBILITY: 1 कि.मी. तक UP TO 1 Km.	1-4 कि.मी. 1-4 Kms.	4-10 कि.मी. 4-10 Kms.	10-20 कि.मी. 10-20 Kms.	20 कि.मी. से अधिक OVER 20 Kms.
जनवरी JAN	0.6	6.7	21.3	2.3	0.1
	0.0	1.8	3.1	24.1	1.9
फरवरी FEB	0.1	7.8	18.0	1.7	0.5
	0.0	0.4	4.2	21.2	2.2
मार्च MAR	0.0	3.8	24.1	2.9	0.3
	0.0	0.3	4.4	24.2	2.1
अप्रैल APR	0.0	3.0	21.5	4.3	1.1
	0.0	0.4	3.8	24.3	1.5
मई MAY	0.0	3.1	22.5	3.4	1.9
	0.0	0.6	3.6	24.4	2.4
जून JUN	0.0	4.7	20.2	3.1	2.0
	0.0	1.1	5.2	21.4	2.3
जुलाई JUL	0.0	4.3	23.1	1.9	1.6
	0.0	1.7	4.7	22.4	2.2
अगस्त AUG	0.0	4.1	22.8	2.5	1.6
	0.0	2.8	3.9	22.7	1.6
सितम्बर SEP	0.0	3.2	20.9	3.6	2.3
	0.0	1.3	4.5	22.2	2.1
अक्तूबर OCT	0.1	3.7	22.4	3.8	1.1
	0.1	1.5	3.9	23.6	2.0
नवम्बर NOV	0.0	8.8	17.8	2.9	0.4
	0.1	3.7	5.3	17.6	3.4
दिसम्बर DEC	0.1	6.8	20.8	3.3	0.0
	0.0	4.6	3.3	21.9	1.1
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	0.8	60.1	255.4	35.6	13.0
	0.1	20.1	49.9	269.9	25.0
वर्षों की सं NUMBER OF YEARS	22				

1423356/2023/ISG-ELECTRICAL

ANNEXURE-2- QAP

Customer: TSGENCO
PROJECT: 5 X 800MW Yadadri TPS
Contractor: BHEL PEM Noida
Doc. No: PE-V0-417-507-E920A, R.0 (QAP FOR EPR FS CABLE·

SR NO	Sheet No	TSGENCO COMMENTS DTD.	BHEL REPLY DTD.: 17.12.2022	TSGENCO/TCE COMMENTS DTD. 21.12.2022	BHEL REPLY DTD.: 09.01.2022
1	Sheet 2 of 7	Please indicate name of Owner and consultants	Noted, included in the revised document	Noted.	Issue closed
2	Sheet 4 & 5 of 7	Type test to be conducted on each size/lot	Please note that QAP for FS cable supplied for Stage-1 (Supplied by M/s Apapr, doc. no: PE-V0-417-507-E920, R.02) has already been approved by TSGENCO with identical sampling plan for final inspection (Type & Acceptance test). However, as insisted by TSGENCO & as a special case sampling plan has been modified to "One size from Power cable & One size from Control cable/Lot" in type test column except for "HOFR characteristic test". In view of the same TSGENCO is requested accept the same.	As per IS-9968, the terminlogy 'LOT' implies that group of same size of cables. So, as per BHEL one size power cable and once size control cable per LOT is suffice the requirement.	Please note that sampling plan defined in IS 9968-1 clause no 21.2.1 is **recommended sampling plan for acceptance test only**. In view of the same Acceptance test shall be carried out on each size of cable except HOFR characteristic test, for HOFR characteristic test sampling shall be on any one sample per lot. Further For Type Test (Except HOFR Characteristics) sampling shall be One size from Power cable & One size from Control cable (Subject to Raw Material from same batch). If raw material from 2 different batch is used then sampling shall be done from cables manufactured form both batch i.e. One size from Power cable & One size from Control cable from 1st bath manufactured cables & One size from Power cable & One size from Control cable from 2nd bath manufactured cables. In view of the same TSGENCO is requested to accept the same and approve the revised QAP.
3	Sheet 6 of 7	Acceptance test to be conducted on each size/lot	Please note that QAP for FS cable supplied for Stage-1 (Supplied by M/s Apapr, doc. no: PE-V0-417-507-E920, R.02) has already been approved by TSGENCO with identical sampling plan for final inspection (Type & Acceptance test). Further already "three samples/Lot" shall be tested as per QAP, hence TSGENCO is requested to accept the same.	As per IS-9968, the terminology 'LOT' implies that group of same size of cables. So, as per BHEL three sample per LOT is suffice the requirement.	Refer reply to point no-2 above.

BHARAT HEAVY ELECTRICALS LTD
PROJECTS ENGINEERING MANAGEMENT
(ELECTRICAL)

This approval status shall be interpreted as laid down in the contract and it shall not relieve the contractor from his contractul obligations.

APPROVAL CATEGORY AWARDED

CAT I	=	Approved
CAT II	=	Approved with comments as noted
CAT III	=	Not Approved
CAT IV	=	Reference Drawing

Name: Signature:

Date:

QUALITY PLAN FOR
EPR INSULATED FIRE SURVIVAL CABLE

CHIEF ENGINEER
Thermal Projects Construction
TSGENCO, Vidyut Soudha,
Khairatabad, Hyderabad - 82.

OWNER: TELANGANA STATE POWER GENERATION CORPORATION LTD
TELANGANA, INDIA
5 x 800 MW YADADRI TPS, NALGONDA

TATA CONSULTING ENGINEERS LIMITED
BANGALORE

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

SUYOG ELECTRICALS LIMITED

JOB NO. 417
STATUS CONTRACT
DISTRIBUTION

TITLE QUALITY PLAN FOR EPR INSULATED FIRE SURVIVAL CABLE

DRAWING NO. PE-V0-417-507-E920A
SHEET 1 OF 1

MANUFACTURER'S NAME & ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : 5 X 800 MW YADADRI STPS
	CABLE TYPE: ELASTOMERIC FLEXIBLE CABLE 1100 VOLTS	CUSTOMER: TSGENCO CONSULTANT: TCE CONTRACTOR: BHEL

Sr. No.		CHARACTERISTICS	CATEGORY OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS / REF. STANDARDS	FORMAT OF RECORD	TESTING M	TESTING C	TESTING A	REMARKS
1	2	3	4	5	6	7	8	9	10			11
A.	RAW MATERIAL RECEIVING INSPECTION & TESTING											
1	COPPER ROD	a) Resistivity at 20°C	Cr	Elect.	1 Sample / Lot	IS 8130 / ASTM B-49	IS 8130 / ASTM B-49	Incoming inspection test report	P	--	--	
		b) Tensile Strength	Maj	Phy.	----do----	IS:12444/ IS 8130	IS:12444/ IS 8130		P	--	--	
		c) Elongation at Break	Maj	Phy.	----do----	----do----	----do----		P	--	--	
		d) Surface Appearance	Maj	Vis.	----do----	----do----	----do----		P	--	--	
		e) Conductivity	Maj	Elect.	----do----	----do----	----do----		P	--	--	
		f) Purity of Copper/ Chemical composition	Maj	Chem.	----do----	Supplier TC	Supplier TC		P	--	--	
2	Separator TAPE (Polyester Tape)	a) Dimensions	Maj	Meas.	1 Sample / Lot	Data Sheet	Data Sheet		P	--	--	
3	INSULATION (EPR IE 2) (on moulded sheet)	a) T.S. & Elong.(Without Ageing)	Maj	Phy.	1 Sample / Lot	IS 6380	IS 6380		P	--	--	
4	SHEATH (HOFR SE 3)	a) T.S. & Elong.(Without Ageing)	Maj	Phy.	1 Sample / Lot	IS 6380	IS 6380		P	--	--	
5	TEST ON ARMOUR WIRE FOR (Multi core & single core copper Cable) (GI WIRE OR AL WIRE as applicable)	a) Measurement of dimensions	Maj.	Phy.	1 Sample / Lot	IS 3975	IS 3975		P	--	--	
		b) Tensile Strength	Maj.	Phy.	----do----	----do----	----do----		P	V	--	
		c) Elongation test (As applicable)	Maj.	Phy.	----do----	----do----	----do----		P	V	--	
		d) Torsion test (As applicable)	Maj.	Phy.	----do----	----do----	----do----		P	V	--	
		e) Resistance test (As applicable)	Cr	Elect	----do----	----do----	----do----		P	V	--	
		f) Zinc coating test (As applicable)	Maj.	Chem.	----do----	----do----	----do----		P	--	--	
6	MICA TAPE	a) Thickness of tape	Maj.	Phy.	----do----	Supplier TC	Supplier TC/T.P.		P	V	--	
		b) Width of tape	Maj.	Meas.	----do----	----do----	----do----		P	--	--	
		c) Tensile Strength	Maj.	Phy.	----do----	----do----	----do----		P	--	--	
7	WOODEN DRUM	a) Dimension	Maj.	Meas.	100%	IS:10418/84, PDS	IS:10418/84, PDS	Reg./Sheet	P	--	--	

CHIEF ENGINEER
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Sr. No.		CHARACTERISTICS	CATEGORY OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS / REF. STANDARDS	FORMAT OF RECORD	TESTING			REMARKS
									M	C	A	
1	2	3	4	5	6	7	8	9	10			11
B.	INPROCESS INSPECTION & TESTING											
1	CONDUCTOR											
	A) WIRE DRAWING	a) Wire Dia	Maj	Meas	1 Sample / Setting	Data Sheet /T.P.	PDS/T.P.	Reg./Sheet	P	V	--	
	B) ANNEALING	b) Annealing Test	Maj	Phy	----do----	IS 8130	IS 8130	Reg./Sheet	P	V	--	
	C) TINNING	c) Persulphate Test (Continuity check of tinned coating)	Maj	Chem	----do----	IS 8130	IS 8130	Reg./Sheet	P	V	--	
2	BUNCHING	a) No & Dia of Wire (Cross section)	Maj	Count	At the time of M/C Setting and twice in each shift	Data Sheet /T.P.	PDS/T.P.	Reg./Sheet	P	V	V	
		b) Dia. Over Bunch	Maj	Meas	----do----	PDS/T.P.	PDS/T.P.	Reg./Sheet	P	V	V	
3	STRANDING (Whereas applicable)	a) No. of Bunch	Maj	Count	----do----	PDS/T.P.	PDS/T.P.	Reg./Sheet	P	V	--	
		b) Conductor Dia	Maj	Meas	----do----	PDS/T.P.	PDS/T.P.	Reg./Sheet	P	V	--	
		c) Lay Length & Direction	Maj	Meas	----do----	PDS/T.P.	PDS/T.P.	Reg./Sheet	P	V	--	
		d) Surface appearance	Maj	Vis	100%	PDS/T.P.	PDS/T.P.	----		--	--	
		e) C.R. at 20°C	Cr	Elect	At the time of M/C Setting and twice in each shift	IS 8130	IS 8130	Reg./Sheet	P	V	--	
4	SEPARATOR TAPE ON CONDUCTOR (PTP/MICA Tape)	a) Thickness	Maj	Meas	----do----	PDS/T.P.	PDS/T.P.	Reg./Sheet	P	V	--	
		b) Dia over Separator	Maj	Meas	----do----	PDS/T.P.	PDS/T.P.	Reg./Sheet	P	V	--	
		c) Overlap & Coverage	Maj	Meas	----do----	PDS/T.P.	PDS/T.P.	Reg./Sheet	P	V	--	
5	INSULATION (TYPE - EPR)	a) Thickness of insulation	Maj	Meas	----do----	IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	Reg./Sheet	P	V	--	
		b) Diameter over insulation	Maj	Meas	----do----	IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	Reg./Sheet	P	V	--	
		c) Core Colour	Maj	Vis	----do----	IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	Reg./Sheet	P	V	--	
		d) T.S. & E.B. (Without Ageing)	Maj	Phy	1 Sample/Shift	IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	Reg./Sheet	P	V	--	
		e) Spark test/HV test	Cr	Elect.	100%	IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	Reg./Sheet	P	V	V	
		f) Hot set & permanent Set	Maj	Phy.	100%	IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	Reg./Sheet	P	V	--	
		g) Surface Finish	Visual	Visual	100%	IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	Reg./Sheet	P	V	--	
6	CORE IDENTIFICATION (Whereas applicable)	a) Coloured R.C. tape	Maj.	Vis.	100%	PDS/T.P.	PDS/T.P.	Reg./Sheet	P	V	--	

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Sr. No.		CHARACTERISTICS	CATEGORY OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS / REF. STANDARDS	FORMAT OF RECORD	TESTING			REMARKS
									M	C	A	
1	2	3	4	5	6	7	8	9	10			11
7	LAYING UP OF CORES (Whereas appliable)	a) No. of cores/ Core Sequence	Maj	Count	100%	Data Sheet	PDS/T.P.	Reg./Sheet	P	V	--	
		b) Dia of Laid up Cores	Maj	Meas	-----do-----	Data Sheet	PDS/T.P.	Reg./Sheet	P	V	--	
		c) Size of fillers (wherever applicable)	Min	Meas	-----do-----	Data Sheet	PDS/T.P.	Reg./Sheet	P	V	--	
		d) Coverage & Overlapp	Maj	Meas	As per plant manufacturing std	As per plant manufacturing std	PDS/T.P.	Reg./Sheet	P	V	--	
8	MICA TAPE (As applicable)	a) Coverage	Maj	Meas	100%	Data Sheet	PDS/T.P.	Reg./Sheet	P	V	--	
		b) Overlap - 10 %	Maj	Meas	100%	Data Sheet	PDS/T.P.	Reg./Sheet	P	V	--	
9	INNER / OUTER SHEATH	a) Colour	Maj	Vis	100%	IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	---	P	--	--	
		b) Radial Thickness	Maj	Meas	At the time of M/C Setting and once in each shift	Data Sheet	PDS/T.P.	Reg./Sheet	P	V	--	
		c) Dia Over outersheath	Maj	Meas	-----do-----	Data Sheet	PDS/T.P.	Reg./Sheet	P	--	--	
10	CABLE IDENTIFICATION	a) Embossing on Outer Sheath	Maj	Vis	100%	Data Sheet	Data Sheet / TP	---	P	--	--	
11	REWINDING	a) Surface	Maj	Vis	100%	Data Sheet	Data Sheet / TP	---	P	--	--	
C.	FINAL INSPECTION & TESTING											
1	ROUTINE TEST	a) High Voltage Test on full drum length	Cr	Elect	100%	IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	Reg./Sheet	P	W	W	
		b) C.R. at 20°C on full drum length	Cr	Elect	100%	IS 8130	IS 8130	Reg./Sheet	P	W	W	
2	TYPE TEST											
	A) CONDUCTOR	a) C.R. at 20°C	Cr	Elect	One size from Power cable & One size from Control cable/Lot	IS 8130	IS 9968/Pt-1/1988	TTR AIL	P	W	W	
		d) Annealing Test	Maj	Phy		IS 8130	IS 9968/Pt-1/1988	TTR AIL	P	W	W	
		c) Persulphate Test (Continuity check of tinned coating)	Maj	Chem		IS 8130	IS 9968/Pt-1/1988	TTR AIL	P	W	W	
		d) Resistance of drain wire	Maj	Elect		IS 8130	IS 9968/Pt-1/1988	TTR AIL	P	W	W	

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Sr. No.		CHARACTERISTICS	CATEGORY OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS / REF. STANDARDS	FORMAT OF RECORD	TESTING			REMARKS
									M	C	A	
1	2	3	4	5	6	7	8	9	10			11
	D) INSULATION (EPR IE - 2)	a) Radial Thickness	Maj	Meas	One size from Power cable & One size from Control cable/Lot	IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	Type Test once conducted shall be remain valid for 05 years
		b) T.S. & E.B. without Ageing	Maj	Phys		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		c) Variation in T.S. & E.B. After Ageing in air oven	Maj	Phys		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		d) Ageing in air Bomb	Maj	Phys		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		e) Hot Set Test & Permanent Set	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		f) Water Absorption (Electrical)	Cr	Elect		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
	C) SHEATH (HOFR SE 3)	a) Radial Thickness	Maj	Meas		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		b) Overall dia	Min	Meas		Data Sheet	Data Sheet	TTR AIL	P	W	W	
		c) T.S. & E.B. without Ageing	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		d) Ageing test at air Bomb	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		e) Oil Resistance Test	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		f) Hot Set Test & Permanent Set	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
	D) HOFR CHARACTERSTISTICS	a) Oxygen Index	Maj	Phy	One size/Lot	IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		b) Temparature Index	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		c) Acid Gas Generation	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		d) Smoke density rating	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		e) Flammability test - IEEE 383	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		f) Flammability test - IEC 331-21 (750 Deg C for 03 Hours)	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		h) Flammability test - Swedish Standard SS-424-1475 (1977)	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
	E) ELECTRICAL TEST	a) High Voltage Test	Cr	Elect	One size from Power cable & One size from Control cable/Lot	IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	TTR AIL	P	W	W	
		b) I. R Constant at R.T. & at 90°C	Cr	Elect		IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	TTR AIL	P	W	W	
	F) TEST ON ARMOUR for Multi core & single core cables	Measurement of dimensions	Maj	Phy.		IS 3975	IS 3975	TTR AIL	P	W	W	
		Tensile Strength	Maj	Phy.		---do---	---do---	TTR AIL	P	W	W	
		Elongation test (As applicable)	Maj	Phy.		---do---	---do---	TTR AIL	P	W	W	
		Torsion test (As applicable)	Maj	Phy.		---do---	---do---	TTR AIL	P	W	W	
		Resistance test (As applicable)	Cr	Elect		---do---	---do---	TTR AIL	P	W	W	
		Zinc coating test (As applicable)	Maj	Chem		---do---	---do---	TTR AIL	P	W	W	

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Sr. No.		CHARACTERISTICS	CATEGORY OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS / REF. STANDARDS	FORMAT OF RECORD	TESTING			REMARKS
									M	C	A	
1	2	3	4	5	6	7	8	9	10			11
3	ACCEPTANCE TEST											
		a) Conductor resistance at 20°C	Cr	Elect	One sample from each size of cable Rev.02	IS 9968/Pt-1/1988	IS 8130	ATR	P	W	W	
		b) Radial Thickness of Insulation & Sheath	Maj	Meas		IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	ATR	P	W	W	
		c) Overall diameter	Maj	Meas		IS 9968/Pt-1/1988/Data Sheet	IS 9968/Pt-1/1988/Data Sheet	ATR	P	W	W	
		d) T.S. & E.B. for Insulation & Sheath without ageing	Maj	Phy		IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	ATR	P	W	W	
		e) Hot Set & Permanent Set test (Insulation & Sheath)	Maj	Phy		IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	ATR	P	W	W	
		f) Flammability Test	Maj	Phy		IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	ATR	P	W	W	
		g) High Voltage Test (Routine)	Maj	Elect		IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	ATR	P	W	W	
		h) Volume Resistivity/ I.R. Constant	Maj	Elect		IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	ATR	P	W	W	
		i) Colour of insulation & Sheath	Visual	Visual		IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	ATR	P	W	W	
		j) Embossing on cable	Visual	Visual		IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	ATR	P	W	W	
		k) Marking on cable	Visual	Visual		IS 9968/Pt-1/1988	IS 9968/Pt-1/1988	ATR	P	W	W	
	HOFR CHARACTERSTISTICS	a) Oxygen Index	Maj	Phy	Any One sample per Lot	IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		b) Temparature Index	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		c) Acid Gas Generation	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		d) Smoke density rating	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		e) Flammability test (IEEE 383)	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		f) Flammability test - (IEC 331-21) 750 Deg C for 3 hrs.	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	
		g) Flammability test - Swedish Standard SS-424-1475 (1977)	Maj	Phy		IS 9968 / Data sheet	IS 9968 / Data sheet	TTR AIL	P	W	W	

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Sr. No.		CHARACTERISTICS	CATEGORY OF CHECK	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS / REF. STANDARDS	FORMAT OF RECORD	TESTING			REMARKS
									M	C	A	
1	2	3	4	5	6	7	8	9	10			11
D.	PACKING & MARKING											
	A) PACKING & MARKING	a) End Sealing	Maj	Vis	100%	Customer's Tech Spec.,PO	Customer's Tech Spec.,PO	---	P	V	V	
		b) Packing	Maj	Vis	100%	----do----	----do----	---	P	V	V	
		c) Marking/Stenciling Drum painting	Maj	Vis	100%	Customer's Tech Spec.,PO	Customer's Tech Spec.,PO	---	P	V	V	

LEGENDS: M: Manufacturer, C ; Client, A ; Client
P = PERFORM, W = WITNESSE, V = VERIFICATION, R- REVIEW, TTR All.= Internal Type Test Report , ATR - Acceptance Test Report
Maj=Major, Elect.=Electrical, Phy.=Physical, Chem.=Chemical, Cr.=Critical, Vis.=Visual, PDS= Product Data Sheet, T.P.= Approved Technical DATA SHEET

Note: This is to declare that necessary additive will be added in the outer sheath compound to develop the anti termite and anti rodent properties of sheath and to make the cable termite and rodent resistant. The inclusion of this additive will not hamper any other properties of the cable.

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1423356/2023/ISG-ELECTRICAL

BHEL-ISG
PROJECT ENGINEERING –ELECTRICAL

DATE: **19.04.2023**

Annexure-3

PRE-QUALIFICATION REQUIREMENT

Indent reference	**IS-1-15-2001/078**
Projects	**5X800 MW Yadadri TPS**
Name of the Item	**EPR Insulated Fire Survival Cable**

A) TECHNICAL PQ CRITERIA:

1.	Bidder should be a manufacturer of LT Power &/or Control Cables.
2.	Availability of test reports of tests on LT EPR Fire survival cables to establish in-house capability to carry out all routine, type & acceptance tests as per relevant IS/International Standards (except UV Radiation, Hydrolytic stability & Fire survival test) which can be conducted at Govt. Lab/Govt. approved independent Lab).
3.	Availability of type test certificate for LT-EPR fire survival cables for fire survival test conducted at independent lab or witnessed by third party as per relevant IS/international standards
4.	Capacity of manufacturing 200km of Power/Control Cables per month.
5.	Bidder should have manufactured and supplied at least 5 km of LT EPR fire survival cables.
6.	Minimum two (2) nos. purchase orders for Power &/ or Control cables to 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.

INSTRUCTIONS TO BIDDER:

1	Bidder shall submit Company's profile covering Organization Setup, Product Range, Details of Key Personnel, Organization Chart, List of Plants & Machinery, Facility for testing & Inspection.
2	**The following Documentary evidence to be submitted by bidder for PQR evaluation:** **For evaluating** **i.** **S.no. 1, 4: -** Documentary evidences like Chartered Engineer certificate, NSIC Certificate in which capacity is mentioned and manufacturing capacity letter issued by Government agencies, to prove the required criteria. ii. **S. no. 2, 3: -** In house Test Report & Type Test Report with lab details/third party details **For evaluating Sr. No- 5, 6** **i.** Purchase order copy indicating -the project for which order was undertaken -Scope of work -Contact details of order placement agency -BOQ **ii.** Completion certificate from order placement agency/End Customer **OR** MDCC or LR Copies or Bidder certified list of invoices raised to order placement agency indicating major supply and services completion details.

BHEL-ISG
PROJECT ENGINEERING –ELECTRICAL

Important Notes to the Bidder:

1. Bidder should submit credentials/ details/ all the necessary documents properly indexed, along with offer to comply with aforesaid criteria.
2. BHEL reserves the right to reject offer of any bidder based on their poor/ non-performance in past/ present projects/ orders.
3. Bidder to note that the acceptance of the offer is subjected to the "Bidder approval from our customer". Bidder shall provide any additional document required for Customer approval. **In case customer does not approve the credentials of the bidder, the bidder will be technically rejected.**
4. Quotations received from bidders who do not fulfill the PQR shall be summarily rejected without any further evaluation and information to bidders.

Nitin Bihani (Manager /Engg-Electrical)

Venkateshwara Rao V (Manager/Engg-Electrical)

R K Majhi (Sr. Manager/Engg-Electrical)

Sangeetha MA (DGM/Engg-Electrical)

ANNEXURE - 4

BHEL - ISG - BANGALORE

ENGINEERING - ELECTRICAL

BOQ

PROJECT: 5X800MW YADADRI TPS

INDENT NO : IS-1-15-2001/078

ITEM DESCRIPTION :EPR INSULATED FIRE SURVIVAL LT POWER CABLE

Sl No	Description	Quantity	UOM	Drum Length
1	1C*16 sqmm	400	mtrs	1X400
2	1C*70 sqmm	700	mtrs	1X700
3	1C*120 sqmm	2500	mtrs	2X1000+1X500

ANNEXURE-5

COMPLIANCE SHEET

REFERENCE:	BHEL-ISG BANGALORE Technical Specification For EPR INSULATED FIRE SURVIVAL LT POWER CABLE	Specification No. IS-1-15-2001/078
	Name of Project: 5X800MW Yadadri TPS	
	Name of Customer: Telangana State Power Generation Corporation Ltd. (TSGENCO)	

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 is no deviation with respect to specification.

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 Price Bid/Unpriced Bid of the specification shall not be considered (i.e., technical description & quantities as per the specification shall prevail).

BIDDER'S STAMP & SIGNATURE

Annexure-6

GUARANTEED TECHNICAL PARTICULARS
(TO BE SUBMITTED BY SUCCESSFUL BIDDER)

S.No.	Particulars	Unit	Description
1.0	GENERAL		
1.1	Name of Manufacturer	-	
1.2	Place of Manufacture	-	
2.0	STANDARDS APPLICABLE		
2.1	For general specification of EPR Cables	-	
2.2	For conductor material	-	
2.3	For material of inner-sheath & outer-sheath	-	
2.4	For method of tests	-	
2.5	For cable drums	-	
2.6	For oxygen index test	-	
2.7	For flammability test	-	
2.8	For acid gas generation test	-	
2.9	For smoke generation test	-	
2.10	For fire survival test	-	
2.11	Current rating of cables conforms to	-	
2.12	Short circuit rating conforms to	-	
3.0	INFORMATION TO BE FILLED IN FOR EACH SIZE CABLE IN THE FORM OF TABLE		
3.1	No. of cores x size	-	
3.2	Voltage grade (Uo/U)	kV	
3.3	Base current ratings as per standard		
a)	In air	Amp	
b)	In ground	Amp	
c)	ducts	Amp	
3.4	Short circuit rating	kA, sec	
3.5	CONDUCTOR		
a)	Applicable Standard	-	
b)	Material type & grade	-	
c)	No & dia of wires in each core before stranding	no x mm	
d)	Shape	-	
e)	D.C. resistance of conductor at 20 deg. C	ohm/km	

NAME OF VENDOR				REV.	
NAME	SIGNATURE	DATE	SEAL		

f)	A.C. resistance of conductor at 85 deg. C	ohm/km	
g)	A.C. resistance of conductor at 90 deg. C	ohm/km	
h)	Reactance of cable at normal frequency	ohm/km	
i)	Electrostatic capacitance of cable at normal frequency	mF/km	
j)	Maximum conductor temperature	deg. C	
k)	Maximum short circuit temperature	deg. C	
3.6	HEAT BARRIER TAPE		
a)	Applicable Standard	-	
b)	Material	-	
c)	Thickness of tape	mm	
d)	No. of layers, overlap	-	
3.7	INSULATION		
a)	Applicable Standard	-	
b)	Material	-	
c)	Method of cross linking	-	
e)	Method of curing	-	
f)	Process of extrusion	-	
g)	Nominal thickness	mm	
h)	Minimum thickness	mm	
i)	Minimum insulation resistance constant at 27 deg. C	mega ohm/km	
j)	Minimum volume resistivity at 27 deg. C	ohm.cm	
k)	Minimum volume resistivity at 85/90 deg. C	ohm.cm	
l)	Dielectric strength of insulation		
m)	Resistivity of insulation		
n)	Acid gas generation of insulation & tape	%	
3.8	CORE IDENTIFICATION		
a)	Applicable Standard	-	
3.9	INNERSHEATH		
a)	Material & type	-	
b)	Nominal Thickness	mm.	
c)	Minimum Thickness	mm.	
d)	Process of Extrusion	-	
e)	Type & Shape of fillers (if used)	-	
f)	Colour	-	
3.10	ARMOUR		
a)	Applicable Standard	-	

b)	Material	-	
c)	Size/ dimensions	-	
d)	Minimum no. of wires/ formed wires	-	
e)	Maximum DC resistance of armour	-	
f)	Maximum AC resistance of armour	-	
g)	Minimum coverage	-	
3.11	OUTERSHEATH		
a)	Material & type	-	
b)	Nominal Thickness	mm.	
c)	Minimum Thickness	mm.	
d)	Process of Extrusion	-	
e)	Colour	-	
4.0	PERMISSIBLE VARIATION (PROJECT SPECIFIC)		
a)	Voltage variation	%	
b)	Frequency Variation	%	
c)	Combined voltage & frequency	lAbsl	
5.0	CHARACTERISTICS OF HOFR SHEATH (Inner & Outer)		
a)	Oxygen index at 50 deg. C.	-	
b)	Temperature index	-	
c)	Acid gas generation	-	
d)	Smoke density rating	-	
6.0	APPLICABLE TESTS UNDER FIRE CONDITIONS FOR SINGLE CABLE & MULTIPLE CABLES		
7.0	High Voltage Test Voltage	kV	
8.0	Water Absorption Test Voltage	kV	
9.0	CIRCUIT INTEGRITY TEST		
a)	Applicable Standard	-	
b)	Temperature	Deg. C.	
c)	Duration	hrs	
10.0	CABLE DRUMS		
a)	Type & construction	-	
b)	Standard drum length (as per BOQ)	-	
c)	Tolerance on drum length	(+/-) 5%	

11.0	DIAMETERS		
a)	Overall diameter of conductor	mm	
b)	Overall diameter over taped conductor	mm	
c)	Approximate cable diameter of insulated conductor	mm	
d)	Approximate Cable diameter over inner sheath		
e)	Approximate overall diameter of cable		
12.0	Tolerance on overall diameter	(±) mm	
13.0	Minimum bending radius	x O.D.	
14.0	Safe pulling force	kg.	
15.0	Maximum Charging current at nominal voltage (approx.)	amps/km	
16.0	Weight of cable / components	kg./m	
a)	Weight of conductor	-	
b)	Weight of fire barrier tape	-	
c)	Weight of insulation	-	
d)	Weight of polymeric material	-	
e)	Weight of Armour (GS/Aluminium)	-	
f)	Total weight of cable	-	
17.0	Shipping Weight	kg	
18.0	Cable marking on outer sheath	-	

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.

Sr.no 10 - page 3/33- PVC formula to be followed

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	AIF (Single core unarmoured & Multi core armoured)	AIF (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	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)

Sr.no 10 - PVC formula to be followed

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.

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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.

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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

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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

CIN No. U99999MH1970GAPO14629

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Cir. No. 35/DIV/ CAB/05/ 24th April 2018

To Members of the Cable Division, Utilities, Railways & Listed purchasing organizations

Sub: Correction in PV formulae of LT XLPE Power Cable and addition of factors for HT XLPE Power Cables

We have recently published revised Price Variation Clause for LT&HT XLPE Power Cables and made it effective from 1st November 2017 vide Cir. No.111/DIV/CAB/05 dated 5th December 2017

While replying to a query of a buyer it is observed that the polymer factor for LT XLPE Power Cables (both aluminium and copper) was incorrectly represented by Table P2.

We have now corrected the anomaly by correcting the PV formulae of LT XLPE Aluminium and Copper Insulated Cables (Sl. No. D & E) by representing Polymer factor by Table L2.

We have also worked out factors for XLPE, Copper and Steel for 3 core HT XLPE Power Cables for 500 and 630 sq.mm.

We now enclose complete PV clause of Cable by including all the PV formulae of different types of power cable (Sl. No. A to I), polymer factor Table L2 and updated XL4, H2 and H5 Table of factors for your perusal & record.

We request to replace PV clause of Cable already circulated vide Cir. 111/DIV/CAB/05 dated 5th December 2017 with the enclosed PV clause in your records for future use.

Senior Director

Encl: as above

CIN No. U99999MH1970GAP014629

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IEEMA (PVC)/CABLE(R-1)/2017 **Effective from: 1st November 217**

Material Price Variation Clause For PVC And XLPE Insulated 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)**

ALUMINIUM

AlF Variation factor for aluminium

Al Price of Aluminiujm. This price is as applicable of first working day of the month, one month prior to the date of delivery.

Alo Price of aluminium. This price is as applicable on first working day of the month, one month prior to the date of tendering.

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.

Cuo 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.

PVC COMPOUND

PVCc price of PVC compound. This price is as applicable on first working day of the month, one month prior to the date of delivery.

PVCco Price of PVC compound. This price is as applicable on first working day of the month, one month prior to the date of tendering.

CCFAl Variation factor for PVC compound/Polymer for aluminum conductor cable.

CCFCu Variation factor for PVC compound/Polymer for copper conductor cable.

CIN No. U99999MH1970GAP014629

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IEEMA (PVC)/CABLE(R-1)/2017 Effective from: 1st November 217

XLPE COMPOUND

Cc price of XLPE compound. This price is as applicable on first working day of the month, one month prior to the date of delivery.

Cco Price of XLPE compound. This price is as applicable on first working day of the month, one month prior to the date of tendering.

XLFAL Variation factor for XLPE compound for aluminum conductor cable.
XLFCU Variation factor for XLPE compound for Copper conductor cable.

STEEL

FeF Variation factor for steel

FeW Variation factor for round wire steel armouring

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.

Feo 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 R(1)/--/-- 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.

Notes

(a) All prices of raw materials are exclusive of GST amount.
(b) All prices excluding Aluminium & Copper are as on first working day of the month.
(c) The details of prices are as under:

1. Price of Aluminium is LME average Cash SELLER Settlement price of Primary Aluminium in US$ per MT as published by London Metal Bulletin (LME) including Premium for Aluminium Ingot in US$ per MT is converted in Indian Rs./MT.
2. Price of PVC Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer.
3. Price of XLPE Compound (in Rs/MT) is the ex-works price, as quoted by the manufacturer
4. Price of CC copper rods (in Rs/MT) is ex-works price as quoted by the primary producer.
5. 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).

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Price variation formulae for 'Power Cables'

A. Aluminum conductor PVC insulated 1.1 kV power cables

P = Po + AlF (AL – Alo) + CCFAl (PVCc – PVCco) + FeF (Fe - Feo)

For unarmourd multicore cables (without steel armour); FeF = 0

Table References:

ALP	Aluminium conductor in single core unarmoured & multicore cables
P1	Aluminium conductor aluminium armour in single core armoured cables
P2	PVC compound
P3	Steel armour

B. Copper conductor PVC insulated 1.1 kV power cables

P = Po + CuF (Cu – Cuo) + CCFCu (PVCc – PVCco) + Fef (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0
For unarmoured cables; FeF, AlF = 0

Tables References:

CUP	Copper conductor
P2	PVC compound
P3	Steel armour
P4	Aluminium armour

C. Copper conductor PVC insulated 1.1 kV control cables

P = Po + CuF (Cu – Cuo) + CCFCu (PVCc-PVCco) + FeF (Fe-Feo)

For unarmoured cables; FeF = 0

Tables References:

CUC	Copper conductor
P5	PVC compound
P6	Steel armour

D. Aluminum conductor XLPE insulated 1.1 kV power cables

P = Po + AlF (AL – Alo) +XLFAL(CC-Cco)+ CCFAl (PVCc – PVCco) + FeF (Fe - Feo)

For unarmourd multicore cables (without steel armour); FeF = 0

Table References:

ALP	Aluminium conductor in single core unarmoured & multicore cables
P1	Aluminium conductor aluminium armour in single core armoured cables
L2	Polymer (CCFAl)
P3	Steel armour
XL1	XLPE Compound (XLFAL)

E. Copper conductor XLPE insulated 1.1 kV power cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc – PVCco) + Fef (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0

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For unarmoured cables; FeF, AlF = 0

Tables References:

CUP	Copper conductor
L2	Polymer (CCFCu)
P3	Steel armour
P4	Aluminium armour
XL1	XLPE Compound (XLFCu)

F. Copper conductor XLPE insulated 1.1 kV control cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc-PVCco) + FeF (Fe-Feo)

For unarmoured cables; FeF = 0

Tables References:

CUC	Copper conductor
P5	PVC compound
P6	Steel armour
XL2	XLPE Compound

G. For Aluminium conductor XLPE insulated 3.3 to 33 kV power cables

P = Po + AlF (Al – Alo) + XLFAL(CC-Cco)+CCFAl (PVCc – PVCco) + FeF (Fe – Feo)

For unarmoured multicore cables (without steel armour); FeF = 0

Table Refernces:

ALP	Aluminium conductor in single core unarmoured & multicore cables
H1	Aluminium conductor + aluminium armour in single core armoured cables
H2	Polymer
H3/H5	Steel armour (Flat/Round)
XL3/XL4	XLPE Compound (Single core /Multicore)

H. Copper conductor XLPE Insulated 3.3 to 33 kV power cables

P = Po + CuF (Cu – Cuo) + XLFCU (CC-Cco)+ CCFCu (PVCc – PVCco) + FeF (Fe – Feo) + AlF (Al – Alo)

For steel armoured cables; AlF = 0 For aluminium armoured cables; FeF = 0
For unarmoured cables; FeF, AlF = 0

Table References:

CUP	Copper conductor
H2	Polymer
H3/H5	Steel armour (Flat/Round)
H4	Aluminium armour
XL3/XL4	XLPE Compound (Single core /Multicore)

I. Copper conductor XLPE insulated 1.0 and 1.5 kV Solar PV DC cables

P = Po + CuF (Cu – Cuo)
Table CUsdc Copper Conductor

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TABLE ALP

VARIATION FACTOR FOR ALUMINIUM (AIF)
POWER CABLES WITH ALUMINIUM CONDUCTOR
(EXCLUDING SINGLE CORE ARMOURED CABLES)

Nominal Cross Sectional Area (in Sq. mm.)	1 core	2 core	3 core	3.5 core	4 core
2.5	0.007	0.014	0.021	-	0.028
4	0.011	0.023	0.034	-	0.046
6	0.017	0.034	0.052	-	0.069
10	0.029	0.053	0.087	-	0.116
16	0.046	0.091	0.137	-	0.183
25/16	0.073	0.146	0.219	0.262	0.292
35/16	0.101	0.202	0.302	0.345	0.404
50/25	0.137	0.273	0.410	0.478	0.547
70/35	0.197	0.395	0.593	0.687	0.791
95/50	0.274	0.548	0.821	0.949	1.095
120/70	0.346	0.691	1.036	1.221	1.382
150/70	0.425	0.853	1.279	1.464	1.706
185/95	0.533	1.070	1.605	1.861	2.140
225/120	0.655	1.310	1.965	2.287	2.620
240/120	0.703	1.400	2.099	2.421	2.799
300/150	0.879	1.757	2.635	3.033	3.514
400/185	1.126	2.249	3.374	3.873	4.498
500	1.418	2.838	4.256	-	5.675
630	1.828	3.663	5.494	-	7.326
800	2.340	4.679	7.018	-	9.357
1000	2.951	5.890	8.834	-	11.779

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TABLE CUP

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)
POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	1 core	2 core	3 core	3.5 core	4 core
2.5	0.023	0.046	0.069	-	0.092
4	0.036	0.076	0.112	-	0.151
6	0.056	0.112	0.171	-	0.227
10	0.095	0.174	0.286	-	0.382
16	0.151	0.299	0.451	-	0.602
25/16	0.240	0.480	0.720	0.862	0.960
35/16	0.332	0.664	0.993	1.135	1.329
50/25	0.451	0.898	1.348	1.572	1.799
70/35	0.648	1.299	1.950	2.260	2.602
95/50	0.901	1.802	2.700	3.121	3.601
120/70	1.138	2.273	3.407	4.016	4.545
150/70	1.398	2.806	4.207	4.815	5.611
185/95	1.753	3.519	5.279	6.121	7.038
225/120	2.154	4.309	6.463	7.522	8.617
240/120	2.312	4.605	6.904	7.963	9.206
300/150	2.891	5.779	8.667	9.976	11.558
400/185	3.703	7.397	11.097	12.738	14.794
500	4.664	9.334	13.998	-	18.665
630	6.012	12.048	18.070	-	24.095
800	7.696	15.389	23.082	-	30.775
1000	9.706	19.372	29.055	-	38.741

TABLE CUsdc

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)
1.0 & 1.5KV Solar PV DC Cables with Copper Conductor

Cable Size in sq.mm.	Copper content in MT/km
2.5	0.023
4	0.038
6	0.058
10	0.090

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TABLE CUC

VARIATION FACTOR FOR COPPER CONDUCTOR (CUF)
CONTROL CABLES WITH COPPER CONDUCTOR

No of Cores	Core size 1.5 sq mm	Core size 2.5 sq mm
2	0.026	0.047
3	0.039	0.070
4	0.052	0.094
5	0.065	0.117
6	0.078	0.141
7	0.091	0.164
8	0.110	0.182
9	0.117	0.205
10	0.130	0.235
12	0.157	0.282
14	0.183	0.329
16	0.209	0.376
18	0.246	0.410
19	0.248	0.446
20	0.260	0.456
24	0.313	0.563
27	0.352	0.634
30	0.391	0.704
37	0.483	0.869
44	0.573	1.033
52	0.678	1.221
61	0.796	1.432

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TABLE P1

VARIATION FACTOR FOR ALUMINIUM (AIF)

ALUMINIUM ARMOURED SINGLE CORE PVC INSULATED 1.1 KV CABLES

Nominal cross sectional area (in Sq.mm)	Aluminium factor for Aluminium armoured cable with aluminium conductor
4	0.0685
6	0.0795
10	0.1017
16	0.1303
25	0.1693
35	0.2090
50	0.2597
70	0.3360
95	0.4567
120	0.5443
150	0.6427
185	0.7743
240	0.9737
300	1.2582
400	1.5502
500	1.8958
630	2.3650
800	2.9306
1000	3.7666

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TABLE P2

VARIATION FACTOR FOR PVC COMPOUND (CCFAI/CCFCu)

PVC INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal cross Sectional Area (in Sq. mm)	1 core	2 core		3 core		3.5 core		4 core	
	Unarm	Unarm	arm	Unarm	arm	Unarm	arm	Unarm	arm
2.5	0.079	0.125	0.139	0.141	0.157	-	-	0.161	0.179
4	0.094	0.140	0.156	0.164	0.182	-	-	0.188	0.209
6	0.101	0.154	0.171	0.179	0.199	-	-	0.198	0.220
10	0.114	0.194	0.216	0.214	0.238	-	-	0.249	0.277
16	0.142	0.234	0.246	0.279	0.290	-	-	0.328	0.345
25	0.171	0.288	0.303	0.364	0.383	0.422	0.444	0.443	0.466
35	0.189	0.321	0.338	0.403	0.429	0.489	0.515	0.498	0.524
50	0.211	0.411	0.433	0.508	0.535	0.613	0.645	0.647	0.681
70	0.241	-	-	0.613	0.645	0.707	0.744	-	-
95	0.284	-	-	0.795	0.811	0.908	0.927	-	-
120	0.339	-	-	0.866	0.884	1.024	1.045	-	-
150	0.388	-	-	1.070	1.092	1.289	1.315	-	-
185	0.450	-	-	1.310	1.337	1.499	1.530	-	-
225	0.521	-	-	1.586	1.618	1.840	1.878	-	-
240	0.534	-	-	1.649	1.683	1.990	2.031	-	-
300	0.653	-	-	2.007	2.048	2.361	2.409	-	-
400	0.770	-	-	2.437	2.487	2.616	2.669	-	-
500	0.936	-	-	3.117	3.181	3.687	3.762	-	-
630	1.175	-	-	-	-	-	-	-	-
800	1.433	-	-	-	-	-	-	-	-
1000	1.642	-	-	-	-	-	-	-	-

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TABLE P3

VARIATION FACTOR FOR STEEL (FeF)

PVC INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal Cross sectional Area (in Sq. mm)	2 core	Shape	3 core	Shape	3 ½ core	Shape	4 core	Shape
4	0.305	W	0.335	W	-	-	0.363	W
6	0.348	W	0.363	W	-	-	0.407	W
10	0.392	W	0.407	W	-	-	0.293	F
16	0.235	F	0.293	F	-	-	0.323	F
25	0.293	F	0.352	F	0.382	F	0.382	F
35	0.323	F	0.382	F	0.411	F	0.440	F
50	0.382	F	0.440	F	0.469	F	0.499	F
70	0.411	F	0.499	F	-	F	0.587	F
95	0.499	F	0.587	F	0.616	F	0.645	F
120	0.528	F	0.616	F	0.675	F	0.731	F
150	0.587	F	0.675	F	0.731	F	0.790	F
185	0.645	F	0.761	F	0.820	F	0.879	F
240	0.731	F	0.879	F	0.937	F	0.996	F
300	0.820	F	0.966	F	1.055	F	1.113	F
400	0.937	F	1.083	F	1.172	F	1.231	F
500	1.055	F	1.231	F	1.348	F	1.406	F
630	1.172	F	-	-	-	-	-	-

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TABLE P3 (Additional)

VARIATION FACTOR FOR ROUND WIRE 'W' STEEL (FeF)

PVC INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in sq. mm)	2 Core	3 Core	3 .5 Core	4 Core
1.5	0.247	0.259		0.288
2.5	0.273	0.289		0.329
4	0.305	0.335		0.363
6	0.348	0.363		0.407
10	0.392	0.407		0.533
16	0.439	0.523	0.014	0.573
25	0.526	0.625	0.664	0.685
35	0.591	0.685	0.729	0.761
50	0.661	0.790	0.864	1.108
70	0.745	1.122	1.200	1.256
95	1.085	1.286	1.376	1.443
120	1.147	1.386	1.479	1.562
150	1.267	1.526	1.684	2.173
185	1.403	2.090	2.315	2.421
240	1.994	2.397	2.641	2.722
300	2.180	2.642	3.670	3.842
400	2.987	3.728	4.126	4.292
500	3.517	4.226	5.958	6.301
630	4.774	6.018	6.737	7.141

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TABLE P4

VARIATION FACTOR FOR ALUMINIUM (AIF)
PVC INSULATED 1.1 KV POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	Aluminium Factor for Aluminium armoured cable with copper conductor
4	0.058
6	0.063
10	0.073
16	0.084
25	0.096
35	0.108
50	0.123
70	0.139
95	0.183
120	0.198
150	0.218
185	0.241
240	0.271
300	0.379
400	0.424
500	0.478
630	0.537
800	0.591
1000	0.816

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TABLE P5

VARIATION FACTOR FOR PVC COMPOUND (CCFCu)
PVC INSULAYTED CONTROL CABLES WITH COPPER CONDUCTOR

No of cores	Core size 1.5 sq mm		Core size 2.5 sq mm	
	Unarm	Arm	Unarm	Arm
2	0.118	0.121	0.125	0.139
3	0.121	0.131	0.141	0.157
4	0.137	0.152	0.161	0.179
5	0.157	0.174	0.187	0.206
6	0.179	0.199	0.234	0.260
7	0.179	0.199	0.234	0.260
8	0.193	0.215	0.292	0.325
9	0.216	0.241	0.300	0.335
10	0.236	0.262	0.303	0.337
12	0.249	0.277	0.334	0.371
14	0.311	0.327	0.389	0.409
16	0.344	0.362	0.435	0.458
18	0.352	0.371	0.474	0.500
19	0.375	0.395	0.476	0.501
20	0.391	0.412	0.519	0.546
24	0.457	0.481	0.584	0.615
27	0.491	0.517	0.631	0.664
30	0.529	0.557	0.706	0.743
37	0.615	0.647	0.835	0.879
44	0.739	0.778	1.019	1.026
52	0.845	0.889	1.100	1.158
61	0.952	1.002	1.246	1.312

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TABLE P6

VARIATION FACTOR FOR STEEL (FeF)

PVC INSULATED CONTROL CABLES WITH COPPER CONDUCTOR

No of cores	Core size 1.5 sq mm	Shape of armour	Core size 2.5 sq mm	Shape of armour
2	0.243	W	0.277	W
3	0.257	W	0.289	W
4	0.277	W	0.314	W
5	0.303	W	0.342	W
6	0.329	W	0.379	W
7	0.329	W	0.379	W
8	0.341	W	0.456	W
9	0.383	W	0.275	F
10	0.408	W	0.325	F
12	0.289	F	0.342	F
14	0.306	F	0.360	F
16	0.317	F	0.372	F
18	0.332	F	0.350	F
19	0.343	F	0.397	F
20	0.368	F	0.400	F
24	0.398	F	0.475	F
27	0.414	F	0.478	F
30	0.425	F	0.503	F
37	0.461	F	0.548	F
44	0.507	F	0.601	F
52	0.556	F	0.641	F
61	0.585	F	0.685	F

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TABLE P6 (Additional)

VARIATION FACTOR FOR ROUND WIRE 'W' STEEL (FeF)
PVC INSULATED CONTROL CABLES WITH COPPER CONDUCTOR

No. of Cores	Core size 1.5 sq mm	Core size 2.5 sq mm
2	0.243	0.273
3	0.257	0.289
4	0.277	0.314
5	0.303	0.342
6	0.329	0.379
7	0.329	0.379
8	0.341	0.456
9	0.383	0.508
10	0.408	0.535
12	0.510	0.572
14	0.546	0.625
16	0.581	0.660
19	0.608	0.696
24	0.714	0.819
25	0.679	0.798
27	0.732	0.837
28	0.696	0.815
30	0.758	0.881
33	0.747	0.883
37	0.820	1.217
44	0.926	1.355
48	1.122	1.308
50	1.122	1.308
52	1.149	1.361
56	1.202	1.388
61	1.299	1.520

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TABLE L2

VARIATION FACTOR FOR POLYMER (CCFAI / CCFCu)
XLPE INSULATED 1.1 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	1 core	2 core		3 core		3.5 core		4 core	
	Unarm	Unarm	Arm	Unarm	Arm	Unarm	Arm	Unarm	Arm
2.5	0.055	0.163	0.175	0.166	0.177	-	-	0.177	0.188
4	0.075	0.201	0.204	0.205	0.213	-	-	0.218	0.213
6	0.085	0.213	0.234	0.205	0.230	-	-	0.242	0.232
10	0.082	0.252	0.280	0.217	0.251	-	-	0.285	0.298
16	0.089	0.278	0.341	0.289	0.246	-	-	0.300	0.279
25	0.101	0.307	0.278	0.276	0.247	0.295	0.264	0.331	0.290
35	0.109	0.330	0.319	0.305	0.270	0.328	0.292	0.368	0.319
50	0.124	0.482	0.685	0.348	0.311	0.372	0.335	0.422	0.394
70	0.146	0.354	0.335	0.469	0.397	0.489	0.420	0.528	0.464
95	0.163	0.436	0.389	0.504	0.441	0.544	0.471	0.591	0.523
120	0.176	0.475	0.421	0.556	0.498	0.599	0.538	0.722	0.656
150	0.217	0.510	0.490	0.690	0.611	0.717	0.633	0.840	0.762
185	0.236	0.631	0.608	0.836	0.738	0.854	0.756	1.007	0.899
240	0.273	0.750	0.726	1.002	0.842	1.079	0.952	1.238	1.119
300	0.303	0.919	0.887	1.161	1.012	1.170	1.031	1.457	1.414
400	0.372	1.093	1.040	1.376	1.283	1.545	1.379	1.778	1.626
500	0.413	1.342	-	1.568	1.400	1.806	1.456	-	-
630	0.469	1.546	-	-	-	-	-	-	-
800	0.569	-	-	-	-	-	-	-	-
1000	0.667	-	-	-	-	-	-	-	-

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TABLE XL1
VARIATION FACTOR FOR XLPE COMPOUND (XLFAL/XLFCU)
XLPE INSULATED 1.1 KV POWER CABLES WITH COPPER/ALUMINIUM CONDUCTOR

Nominal cross Sectional Area (in Sq. mm)	1 core		2 core		3 core		3.5 core		4 core	
	Unarm	Arm	Unarm	Arm	Unarm	arm	Unarm	Arm	Unarm	arm
2.5	0.007	0.010	0.014	0.014	0.021	0.021			0.028	0.028
4	0.009	0.012	0.018	0.018	0.027	0.027			0.036	0.036
6	0.010	0.015	0.022	0.022	0.033	0.033			0.043	0.043
10	0.013	0.018	0.025	0.025	0.039	0.039			0.053	0.053
16	0.016	0.023	0.034	0.034	0.049	0.049			0.065	0.065
25	0.021	0.030	0.048	0.048	0.070	0.070	0.084	0.084	0.093	0.093
35	0.025	0.035	0.059	0.059	0.084	0.084	0.099	0.099	0.112	0.112
50	0.033	0.044	0.075	0.075	0.108	0.108	0.130	0.130	0.144	0.144
70	0.042	0.054	0.095	0.095	0.137	0.137	0.160	0.160	0.179	0.179
95	0.048	0.062	0.110	0.110	0.160	0.160	0.190	0.190	0.211	0.211
120	0.060	0.076	0.138	0.138	0.200	0.200	0.239	0.239	0.266	0.266
150	0.078	0.095	0.180	0.180	0.259	0.259	0.296	0.296	0.344	0.344
185	0.097	0.116	0.224	0.224	0.324	0.324	0.369	0.369	0.430	0.430
240	0.116	0.137	0.266	0.266	0.388	0.388	0.446	0.446	0.518	0.518
300	0.138	0.164	0.325	0.325	0.467	0.467	0.540	0.540	0.620	0.620
400	0.175	0.214	0.357	0.357	0.536	0.536	0.619	0.619	0.714	0.714
500	0.217	0.260	0.440	0.440	0.660	0.660	0.769	0.769	0.880	0.880
630	0.265	0.318	0.542	0.542	0.814	0.814	0.941	0.941	1.085	1.085
800	0.323	0.389								
1000	0.375	0.444								

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TABLE XL2
VARIATION FACTOR FOR XLPE COMPOUND (XLFCU)
XLPE INSULAYTED CONTROL CABLES WITH COPPER CONDUCTOR

No of cores	Core size 1.5 sq mm		Core size 2.5 sq mm	
	Unarm	Arm	Unarm	Arm
2	0.010	0.010	0.012	0.012
3	0.016	0.016	0.018	0.018
4	0.021	0.021	0.025	0.025
5	0.026	0.026	0.031	0.031
6	0.031	0.031	0.037	0.037
7	0.036	0.036	0.043	0.043
8	0.036	0.036	0.043	0.043
9	0.042	0.042	0.049	0.049
10	0.052	0.052	0.061	0.061
12	0.062	0.062	0.074	0.074
14	0.073	0.073	0.086	0.086
16	0.083	0.083	0.098	0.098
18	0.094	0.094	0.110	0.110
19	0.099	0.099	0.116	0.116
20	0.104	0.104	0.123	0.123
24	0.125	0.125	0.147	0.147
27	0.140	0.140	0.165	0.165
30	0.156	0.156	0.184	0.184
37	0.192	0.192	0.227	0.227
44	0.229	0.229	0.270	0.270
52	0.270	0.270	0.319	0.319
61	0.317	0.317	0.374	0.374

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TABLE XL3

VARIATION FACTOR FOR XLPE(XLFAL/XLFCU)

SINGLE CORE ARMOURED /UNARMOURED XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH CU / AL CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	XLPE Factor for Armoured/ Unarmoured Cable with AL /CU Conductor					
	3.3 KV	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	0.110	0.131	0.170	0.279		
35	0.122	0.137	0.175	0.284	0.317	0.522
50	0.135	0.151	0.191	0.307	0.341	0.563
70	0.155	0.172	0.215	0.342	0.379	0.615
95	0.174	0.193	0.241	0.377	0.417	0.670
120	0.192	0.212	0.262	0.407	0.449	0.713
150	0.209	0.229	0.283	0.437	0.481	0.757
185	0.228	0.250	0.308	0.471	0.518	0.809
240	0.255	0.279	0.343	0.519	0.569	0.883
300	0.280	0.322	0.372	0.560	0.613	0.943
400	0.326	0.392	0.420	0.625	0.683	1.041
500	0.388	0.461	0.469	0.694	0.757	1.142
630	0.467	0.520	0.529	0.777	0.845	1.265
800	0.567	0.593	0.602	0.874	0.949	1.407
1000	0.656	0.665	0.660	0.955	1.036	1.525

Note : XLPE factors include Semicons for Conductor & Insulation screen

TABLE – XL4

VARIATION FACTOR FOR XLPE (CCF1Al / CCF1Cu)

3 CORE XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	3.3 KV ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM
25	0.315	0.394	0.511	0.838		
35	0.339	0.427	0.545	0.880	0.982	1.638
50	0.378	0.474	0.600	0.957	1.065	1.751
70	0.435	0.541	0.679	1.067	1.183	1.916
95	0.489	0.604	0.755	1.171	1.295	2.071
120	0.537	0.661	0.822	1.265	1.396	2.210
150	0.585	0.719	0.890	1.359	1.497	2.350
185	0.642	0.784	0.968	1.468	1.614	2.513
240	0.717	0.873	1.074	1.615	1.773	2.732
300	0.781	1.006	1.167	1.744	1.928	2.919
400	0.886	1.227	1.314	1.948	2.130	3.229
500	0.956	1.421	1.446	2.148	2.381	3.538
630	1.129	1.582	1.609	2.382	2.630	3.940

Note : XLPE factors include Semicons for Conductor & Insulation screen

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TABLE H1

VARIATION FACTOR FOR ALUMINIUM (AIF)

ALUMINIUM ARMOURED SINGLE CORE XLPE INSULATED 3.3 TO 33 KV CABLES

Nominal Cross Sectional Area (in Sq. mm.)	Aluminium Factor for Aluminium Armoured Cable with Aluminium Conductor					
	3.3 KV	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
35	0.251	0.284	0.301	0.344	0.358	0.473
50	0.312	0.336	0.352	0.397	0.408	0.672
70	0.385	0.409	0.423	0.469	0.501	0.723
95	0.476	0.500	0.518	0.637	0.656	0.856
120	0.561	0.586	0.601	0.726	0.744	0.949
150	0.653	0.678	0.696	0.823	0.842	1.050
185	0.773	0.797	0.893	0.949	0.965	1.183
240	0.997	1.063	1.083	1.139	1.154	1.387
300	1.209	1.271	1.283	1.333	1.307	1.753
400	1.438	1.556	1.565	1.620	1.636	2.046
500	1.873	1.901	1.910	2.110	2.128	2.484
630	2.337	2.361	2.369	2.580	2.595	2.978
800	3.007	3.071	3.080	3.145	3.163	3.588
1000	3.737	3.741	3.749	3.804	3.822	4.565

TABLE H2

VARIATION FACTOR FOR POLYMER (CCFAI / CCFCu)

3 CORE XLPE INSULATED 3.3 to 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm)	3.3 KV ARM	6.6 KV (E) ARM	6.6 KV (UE) / 11 KV (E) ARM	11 KV (UE) ARM	22 KV (E) ARM	33 KV (E) ARM
35	0.374	0.990	1.142	1.604	1.782	-
50	0.445	1.119	1.260	1.834	2.046	2.864
70	0.547	1.290	1.396	2.011	2.284	3.219
95	0.594	1.440	1.647	2.269	2.428	3.367
120	0.732	1.692	1.877	2.498	2.715	3.646
150	0.812	1.906	2.061	2.767	2.931	3.927
185	0.960	2.086	2.406	3.028	3.180	4.166
240	1.130	2.484	2.744	3.398	3.580	4.589
300	1.219	2.912	3.161	3.840	4.016	5.029
400	1.313	3.530	3.664	4.353	4.666	5.736
500	1.652	3.925	3.971	4.621	4.878	5.913
630	1.949	4.487	4.982	5.225	5.477	6.696

Fillers added in PVC consumption

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TABLE H3
VARIATION FACTOR FOR STEEL (FeF)
XLPE INSULATED 3.3 TO 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area Sq. mm.	3.3 KV	6.6 KV (E)	11 KV (E) / 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	0.551	0.604	0.656	0.814		
35	0.645	0.645	0.731	0.879	0.937	-
50	0.675	0.703	0.761	0.937	0.966	1.181
70	0.761	0.761	0.849	0.996	1.055	1.289
95	0.820	0.849	0.907	1.083	1.113	1.348
120	0.879	0.907	0.966	1.142	1.172	1.406
150	0.966	0.966	1.055	1.201	1.259	1.494
185	1.025	1.055	1.113	1.259	1.318	1.553
240	1.142	1.142	1.231	1.377	1.406	1.641
300	1.231	1.259	1.318	1.465	1.524	1.758
400	1.348	1.406	1.435	1.582	1.641	1.876

TABLE H4

VARIATION FACTOR FOR ALUMINIUM (AIF)

XLPE INSULATED SINGLE CORE 3.3 TO 33 KV POWER CABLES WITH COPPER CONDUCTOR

Nominal Cross Sectional Area (in Sq. mm.)	Aluminium Factor for Aluminium Armoured Cable with Copper Conductor					
	3.3 KV	6.6 KV (E)	11 KV (E)/ 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
35	0.153	0.187	0.204	0.247	0.258	0.372
50	0.179	0.203	0.220	0.262	0.275	0.425
70	0.196	0.219	0.233	0.278	0.311	0.444
95	0.213	0.237	0.254	0.373	0.392	0.470
120	0.228	0.253	0.268	0.393	0.410	0.488
150	0.243	0.269	0.287	0.414	0.432	0.504
185	0.261	0.285	0.381	0.437	0.455	0.526
240	0.324	0.389	0.410	0.465	0.480	0.556
300	0.365	0.428	0.440	0.490	0.510	0.737
400	0.432	0.471	0.480	0.536	0.552	0.783
500	0.489	0.517	0.526	0.726	0.744	0.844
630	0.544	0.568	0.572	0.787	0.801	0.902
800	0.706	0.787	0.797	0.862	0.880	0.982
1000	0.824	0.865	0.867	0.923	0.940	1.324

TABLE - H5

VARIATION FACTOR FOR STEEL (FeW)

XLPE INSULATED 3.3KV TO 33 KV POWER CABLES WITH COPPER / ALUMINIUM CONDUCTOR

Nominal Cross Sectional Area in Sq. mm	3.3/3.3 KV	3.3/6.6 KV	11 KV (E) / 6.6 KV (UE)	11 KV (UE)	22 KV (E)	33 KV (E)
25	1.258	1.457	1.612	2.509	1.503	--
35	1.361	1.569	1.853	2.644	2.797	2.517
50	1.682	1.687	2.321	2.800	2.921	4.569
70	2.033	1.979	2.503	3.219	3.347	4.809
95	2.202	2.507	2.718	4.019	4.200	5.437
120	2.371	2.675	2.882	4.241	4.416	6.713
150	2.870	2.847	3.265	4.447	4.621	6.976
185	3.121	3.309	4.148	4.726	5.289	7.356
240	3.758	4.227	4.442	5.442	6.651	7.718
300	4.099	5.024	5.182	6.894	7.084	8.187
400	5.750	6.572	6.658	7.433	7.657	8.760
500	6.716	6.777	6.861	7.588	7.797	8.830
630	7.492	7.465	7.477	8.209	8.386	9.413