1 x 660 MW BHUSAWAL TPS, UNIT-6

MAHARASHTRA STATE POWER GENERATION CORPORATION LIMITED

TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL CABLES

VOLUME-II

SPECIFICATION NO: PE-TS-415-507-E006

REVISION: 00

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

CONTENTS

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

COMPLIANCE CERTIFICATE

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

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.

2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'

3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.

4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.

5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in Annexure-A [BOQ-Cum-Price schedule] of the specification shall not be considered (i.e., technical description & quantities as per specification shall prevail).

BIDDER'S STAMP & SIGNATURE

1.0 SCOPE OF ENQUIRY

1.1 This specification covers the Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of EPR INSULATED FIRE SURVIVAL CABLES.

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

1.3 General technical requirements of the EPR INSULATED FIRE SURVIVAL CABLES are indicated in Section-II. Project specific technical/ quality requirements / changes are listed in Section-I.

1.4 The stipulations of Section-I, followed by those of Data Sheet-A shall prevail in case of any conflict between the stipulations of Section-I, Data Sheet - A & Section-II.

1.5 The documents shall be in English Language and MKS system of units

2.0 BILL OF QUANTITIES:

2.1 Quantity requirements shall be as per Annexure for Bill of Quantities (BOQ) enclosed as part of NIT.

3.0 TECHNICAL REQUIREMENTS

3.1 Specific Technical Requirement:

S.No.	***Reference Clause No. of Section- II***	***Specific Requirement/ Change***
1.	4.1: Cables shall be supplied in non-returnable drums. Material of cable drums shall be as specified in Datasheet-A.	Shall be read as: "Cables shall be supplied in non-returnable drums, of heavy construction. Material of cable drums shall be as specified in Datasheet-A."
2.	4.2: In case of wooden drums, all wooden parts shall be manufactured from seasoned wood treated with copper napthenates / zinc napthenates (refer IS: 401). Dimensions of wooden drums shall be as per IS 10418. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. BIS certification mark shall be stamped on each cable drum.	Shall be read as: "In case of wooden drums, all wooden parts shall be manufactured from seasoned wood. Wooden cable drum shall be treated by immersing in copper-nitrate solution. Drum number shall be indicated on each drum. Dimensions of wooden drums shall be as per IS 10418. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. 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 before shipment. In case of wooden drums, 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. Wooden drums shall comply with IS: 10418." Wood preservative anti-termite treatment shall be

		applied to the entire drum.

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 BHEL & customer's approval:

Sl. No.	Drawings/Document Description	Drawings / Document Number	Document Type
1.	Technical Data Sheet for EPR INSULATED FIRE SURVIVAL CABLES	PE-V0-415-507-E601	Primary
2.	Cross-sectional Drawings for EPR INSULATED FIRE SURVIVAL CABLES	PE-V0-415-507-E602	Primary
3.	Manufacturing Quality Plan for EPR INSULATED FIRE SURVIVAL CABLES	PE-V0-415-507-E603*	Primary
4.	Type Test Certificates	PE-V0-415-507-E604	Secondary

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).

DATASHEET A

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), IS-6380, IS -10810,IS 10418, IS-3975, ASTMD:2843, ASTMD-2863, IEC-60754-1, IEC-60331, IEC-60332, 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 (for Power Cables having crossectional area more than 2.5 sq.mm)	Stranded, plain, annealed high conductivity, Class 2
	Grade and Class (for Control Cables having crossectional area upto and including 2.5 sq.mm)	Stranded, Tinned, annealed high conductivity, Class 2
(b)	Standard Applicable	IS - 8130
(c)	Shape	Compacted circular / Shaped
(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
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	Two Layers of plain Glass Fibre Binder Tape
7.0	CORE IDENTIFICATION	Colour coding as per IS : 9968(PART-1)
8.0	INNER SHEATH	APPLICABLE FOR BOTH SINGLE & MULTI CORE CABLES
(a)	Material	Heat resistant, oil resistant , flame retardant (HOFR) Elastomer compound
(b)	Grade and type	Extruded Type SE-3
(c)	Standard Applicable	IS : 9968 (PART-1), IS : 6380
(d)	Colour	Black
(e)	Nominal Thickness	As per IS : 9968(PART-1)
9.0	ARMOUR	
(a)	Material:	
(i)	Single core cables (for AC Circuits) Refer Annexure-A (BOQ) for Armour applicable for cable.	Single layer of round Copper Wire for 1C-630 sq.mm cable.
	Single core cables (for DC Circuits) Refer Annexure-A (BOQ) for Armour	Single layer of Galvanised Steel Round Wire for 1C-400 sq.mm cable.

	applicable for cable.	
	Standard Applicable	IS-8130
(ii)	Multi-core Power cables	Galvanised Steel Round Wire
	Multi-core Control cables	Galvanised Steel Round Wire
	Standard Applicable	IS-3975
(b)	Gap between armour wires	Shall not exceed one armour wire space (No cross-over/ over-riding)
(c)	Minimum Coverage	90%
(d)	Breaking load of joint	95 % of normal armour
		Zinc rich paint shall be applied on armour joint surface of GS wire
10.0	OUTERSHEATH	
(a)	Material	Heat resistant, oil resistant , flame retardant (HOFR) Elastomer compound
(b)	Grade and type	Extruded Type SE-3
(c)	Colour	Black or any other colour to be decided during detailed engineering
(d)	Standard Applicable	IS : 9968(PART-1), IS : 6380
(e)	Nominal Thickness	As per IS : 9968(PART-1)
(e)	Marking	Cable size (cross section area and no. of cores) and voltage grade, IS -9968-Part-1 @ 5m (by embossing) Word "EPR-IE2/SE3" "FS" etc, @ 5m (by embossing) Manufacturer's name and/ or trade name, and year of manufacture @ 5m (by embossing) 'BHEL-PEM' and 'MSPGCL' Name @5m (by embossing) Progressive sequential marking @ 1m (by embossing/ printing)
11.0	HOFR CHARACTERISTICS	
(a)	Oxygen index	≥30 (as per ASTMD 2863)
(b)	Temperature Index	≥350ºC (as per ASTMD-2863)
(c)	Acid gas generation	≤ 2% by weight (as per IEC-60754-1)
(d)	Smoke density rating	≤ 20% (As per ASTMD 2843)
(e)	Water absorption test	IS 10810-28
(e)	Flammability Test	
(i)	Flammability test for single cable	IEC-60332 Part-1
(ii)	Flammability test for bunched cables	IEC-60332 Part-3 CAT-B
(iii)	Flammability test for complete cable	As per IEEE-60383
(iv)	Swedish Chimney test	As per SEN-SS-424-1475-F3
(f)	*Fire survival test*	As per IEC-60331 for min 3 Hrs at 750ºC
12.0	Allowable Tolerance on OD	±2 mm (max.)
13.0	CABLE DRUMS	
(a)	Type of Drum	Wooden Drum as per IS 10418.
(b)	Standard drum length	500m (±) 5% (as specified in BOQ-Cum-Price Schedule)
(c)	Painting	Entire surface to be painted. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drums shall be treated by immersing in copper-nitrate solution. Drum number shall be indicated on each drum.
(d)	Outermost Layer	To be covered with water-proof polyethylene
(e)	Particular information on Drum	Both the end of 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 & erection. Wood preservative anti-termite treatment shall be applied to the entire drum.
(f)	Construction Details	As per Section-I of this Technical Specification.
(g)	Marking (in printed form)	a. MSPGCL b. Manufacturer's Name or trade mark c. Type of Cable and Voltage grade d. Year of Manufacture e. Type of Insulation f. Number of core and size of cables g. Cable Code Eg. FS h. Single length of cable on drum i. Direction of rotation by arrow j. Approx. gross mass k. IS/IEC number
14.	Cable Packing	Kindly refer Clause no 4.2 of Section-II of this technical specification & Section-I of this technical Specification. It may be noted that the outer most cable layer shall be covered with water proof cover polythene followed by complete drum covering with wooden plank of suitable thickness across flanges. (Kindly refer typical drawing of cable drum packing, attached in section -II)

NOTE: Suitable fire retardant material fillers shall be used for filling in the interstices. Two layers of plain glass binder tape should be applied over the laid up cores.

DATASHEET C

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	
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		
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	Minimum Tensile strength	N/mm^2	
17.0	Minimum elongation percentage at rupture		
18.0	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	-	
19.0	Shipping Weight	kg	
20.0	Cable marking on outer sheath	-	
21.0	Cable Packing	-	

SECTION-II

STANDARD TECHNICAL SPECIFICATION

1.0 TECHNICAL REQUIREMENTS

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

2.0 CODES & STANDARDS

2.1 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.

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

3.0 QUALITY ASSURANCE REQUIREMENTS

3.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E006 as attached with the specification without any deviations. At contract stage, the successful bidder shall submit the same QP for BHEL/ ultimate customer's approval. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ultimate customer's approval. There shall be no commercial implication to BHEL on account of minor changes in QP during contract stage.

3.2 All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved Quality Plan.

3.3 Type testing requirements, routine / acceptance testing and special testing requirements shall be as per Annexure to QAP. Charges for all these tests for all the equipment & components shall be deemed to be included in the bid price (except UV Radiation test).

3.4 The charges of UV Radiation test (if applicable) shall be reimbursed extra at actual against original money receipt of Govt. Lab. (CPRI/ ERDA etc).

3.5 Cost of cables consumed for testing shall be to bidder's account.

4.0 Packing

4.1 Cables shall be supplied in non-returnable drums. Material of cable drums shall be as specified in Datasheet-A.

4.2 In case of wooden drums, all wooden parts shall be manufactured from seasoned wood treated with copper napthenates / zinc napthenates (refer IS: 401). Dimensions of wooden drums shall be as per IS 10418. All ferrous parts shall be treated with suitable rust protective finish or coating to avoid rusting during transit and storage. BIS certification mark shall be stamped on each cable drum.

4.3 In case of Steel drums, New or practically new cable drums made of steel and painted with epoxy resin paint are to be used. Cable ends are carefully protected before packing. Over the cables polyethylene sheet shall be wrapped and then sealed properly. For Typical details of Steel drums, Annexure-I to Section-II, may be referred by the bidder. Bidder may modify, to choose appropriate dimensions of steel drums to suite various sizes/weight/ lengths of EPR INSULATED FIRE SURVIVAL CABLES.

4.4 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.

ANNEXURE-II

QUALITY PLAN

BHEL	**STANDARD QUALITY PLAN**		CUSTOMER : MAHARASHTRA STATE POWER GENERATION CO. LTD.			PROJECT: 1 X 660MW BHUSAWAL TPS TITLE			SPECIFICATION NUMBER : PE-TS-415-507-E006, R00			
	SHEET 1 OF 11		BIDDER/ VENDOR :			QUALITY PLAN NUMBER: PE-QP-999-507-E006, **R0**			SPECIFICATION TITLE			TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL
			SYSTEM			ITEM : EPR INSULATED FIRE SURVIVAL CABLES			SECTION			VOLUME II

SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
Instructions:												
1. Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch/ lot no. should be traceable to the final cable drum number or batch no.												
2. Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not.												
1.0	**RAW MATERIALS & BOUGHT OUT ITEMS**											
1.1	**Aluminium/copper Rods (Conductor/Armour Wire)**	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample/ Batch	IS 9968 Pt 1,IS 8130 & Appd Datasheet	IS 9968 Pt 1,IS 8130 & Appd Datasheet	Inpection Report/ Test Cert.	2/3	-	1/2	
		2. Elec.Properties	MA	Electrical Tests	Sample/ Batch	-do-	-do-	-do-	2/3	-	1/2	
		SPECIFIC CHECKS :										
		a) Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	2/3	-	1	
		b) Grade	MA	-do-	-do-	IS 8130/ Approved datasheet	IS 8130/ Approved datasheet	-do-	2/3	-	1	
		c) Resistivity	MA	Electrical Tests	Manufacturer std.	IS 8130	IS 8130	-do-	2/3	-	1	
1.2	**Insulation (EPR) Copmpound**	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample/ Batch	IS 9968 Pt 1, IS 6380 & Mfs Std./ Approved datasheet	IS 9968 Pt 1, IS 6380 & Mfs Std./ Approved datasheet	Inpection Repor/ Test Cert.	2/3	-	1/2	
		2. Elec.Properties	MA	Electrical Tests	Sample/ Batch	-do-	-do-	-do-	2/3	-	1/2	
		SPECIFIC CHECKS :										
		a) Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	2/3	-	1	
		b) Type/ Grade	MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	2/3	-	1	
		c) Shelf life/ Storage condition	MA	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	2/3	-	1	

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

	STANDARD QUALITY PLAN		CUSTOMER : MAHARASHTRA STATE POWER GENERATION CO. LTD.			PROJECT: 1 X 660MW BHUSAWAL TPS TITLE			SPECIFICATION NUMBER : PE-TS-415-507-E006, R00			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER: PE-QP-999-507-E006, R0			SPECIFICATION TITLE			TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL
	SHEET 2 OF 11		SYSTEM			ITEM : EPR INSULATED FIRE SURVIVAL CABLES			SECTION			VOLUME II
SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.3	**Seathing Compound**	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample/ Batch	IS 9968 Pt 1 & Mfs Std./ Approved datasheet	IS 9968 Pt 1 & Mfs Std./ Approved datasheet	Inpection Report/ Test Cert.	2/3	-	1/2	
		2. HOFR properties	MA	Envir/Chemical	Sample/ Batch	ASTMD:2843, ASTMD-2863, IEC-60754-1/ Approved datasheet	ASTMD:2843, ASTMD-2863, IEC-60754-1/ Approved datasheet	Inpection Report/ Test Cert.	2/3	-	1/2	
		SPECIFIC CHECKS :										
		1. Make	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	2/3	-	1	
		2. Type/ Grade	MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	2/3	-	1	
		3. Shelf life/ Storage condition	MA	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	2/3	-	1	
1.4	**Glass Mica Tape (Separator Tape)**	**GENERAL :**										
		1. Physical properties	MA	Physical Tests	Sample/ Batch	Mfr. Std./ Approved datasheet	Mfr. Std./ Approved datasheet	Inpection Report/ Test Cert.	2/3	-	1/2	
		2. Elec.Properties	MA	Electrical Tests	Sample/ Batch	-do-	-do-	-do-	2/3	-	1/2	

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

	STANDARD QUALITY PLAN		CUSTOMER : MAHARASHTRA STATE POWER GENERATION CO. LTD.			PROJECT: 1 X 660MW BHUSAWAL TPS TITLE			SPECIFICATION NUMBER :	PE-TS-415-507-E006, R00		
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER: PE-QP-999-507-E006, R0			SPECIFICATION TITLE	EPR INSULATED FIRE SURVIVAL CABLES		
	SHEET 3 OF 11		SYSTEM			ITEM : EPR INSULATED FIRE SURVIVAL CABLES			SECTION	VOLUME II		
SL. NO.	COMPONENT/ OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
1.5	**Galvanised steel round wire/Copper round wire for Armour (as applicable)**	**GENERAL :**										
		1. Make	MA	Verify	Manufacturer std.	Manufacturer approved source	Manufacturer approved source	Inpection Report/ Test Cert.	2/3	-	1	
		2. Dimension	MA	Measurement	-do-	IS 3975 & Approved datasheet	IS 3975 & Approved datasheet	-do-	2/3	-	2	
		3. Phy.and Elec. Properties	MA	Physical & Electrical Tests	Sample*	-do-	-do-	-do-	2/3	-	2	* Sample from each armour size/ Batch / Lot
		4.Galvanization Quality	MA	Galv.Tests	-do-	Relevant. IS & Mfr. Std.	Relevant. IS & Mfr. Std.	-do-	2/3	-	2	
1.6	**Wooden Drum**	1. Phy. And constructional checks	MA	Meas.	Mfr's Plant Std.	IS10418	IS10418	Inpection Report/ Test Cert.	2/3	-	1	
		2. Anti termite treatment	MA	chemical	-do-	Mfr's Plant Std.	Mfr's Plant Std.	COC	2/3		1	
1.7	Steel Drum	1. Dimension	MA	Meas.	Mfr's Plant Std.	Approved drawing of steel drum / BHEL specification	Approved drawing of steel drum / BHEL specification	Inpection Report/ Test Cert.	2/3	-	1	
		2. Surface finish	MA	Meas.	-do-	Surface shall be smooth	Surface shall be smooth	-do-	2/3	-	1	

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

BHEL	**STANDARD QUALITY PLAN**		CUSTOMER : MAHARASHTRA STATE POWER GENERATION CO. LTD.			PROJECT TITLE: 1 X 660MW BHUSAWAL TPS			SPECIFICATION : NUMBER : PE-TS-415-507-E006, R00			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER: PE-QP-999-507-E006, R0			SPECIFICATION TITLE	TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL		
	SHEET 4 OF 11		SYSTEM			ITEM : EPR INSULATED FIRE SURVIVAL CABLES			SECTION	VOLUME II		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.0	**IN PROCESS**											
2.1	**Wire Drawing**	1. Size	MA	Dimensional	Plant Mfg. Std.	IS 8130 & Appd. Datasheet	IS 8130 & Appd. Datasheet	Inpection Report	2	-	1	
		2. Surface finish	MA	Visual	-do-	Surface shall be smooth	Surface shall be smooth	-do-	2	-	1	
		3. Phy.and Elec. Properties	CR	Physical & Electrical Tests	Sample*	IS 8130 & Mfr. Std.	IS 8130 & Mfr. Std.	-do-	2/3	-	2	* Sample from each armour size/ Batch / Lot
2.2	**Stranding of wires**	1. No. of wires	MA	Counting	Plant Mfg. Std.	IS 8130 & Appd. Datasheet	IS 8130 & Appd. Datasheet	Inpection Report	2	-	-	
		2. Resistance	CR	Electrical	-do-	-do-	-do-	-do-	2	-	-	
		3. Sequence, lay length & Direction	MA	Visual, Meas.	One Sample of each size/ lot	Mfrs Std. / Appd. Datasheet	Mfrs Std. / Appd. Datasheet	-do-	2	-	-	
		4. Surface Finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	-do-	2	-	-	
		5. Dimension	MA	Measurement	One Sample of each size/ lot	IS 8130 & Appd. Datasheet	IS 8130 & Appd. Datasheet	-do-	2	-	-	
2.3	**Glass Mica tape**	1. Dimensions	MA	Measurement	100%	Appd. datasheet	Appd. datasheet	Inpection Report	2	-	-	
		2. Dia over tape	MA	Measurement	Sample	Mfrs Std.	Mfrs Std.	-do-	2	-	-	
		3.Mica tape overlap	MA	Measurement	Sample	Appd. datasheet	Appd. datasheet	-do-	2	-	-	
2.4	**Core Insulation (EPR) (No repair permitted)**	1. Surface finish	MA	Visual	100%	Free from bulging, burnt particles, lumps, cuts & scratches	Free from bulging, burnt particles, lumps, cuts & scratches	Inpection Report	2	-	1	
		2. Concentricity#	CR	Measurement	One Sample of each size/ lot	IS 9968 Pt 1 & Appd. Datasheet	IS 9968 Pt 1 & Appd. Datasheet	-do-	2	-	1	*# To be checked at starting & finished end of extruded length.*
		3. Insulation Thickness	CR	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		4. Dia over insulation	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		5. Tensile Strength & % Elongation	MA	Mechanical	100%	-do-	-do-	-do-	2	-	-	
		6. Water absorption test	CR	Electrical	100%	IS 6380 ,Mfrs Std.	IS 6380 ,Mfrs Std.	Inpection Report	2	-	1	
	BHEL		PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

भेल BHEL	**STANDARD QUALITY PLAN**		CUSTOMER : MAHARASHTRA STATE POWER GENERATION CO. LTD.			PROJECT TITLE 1 X 660MW BHUSAWAL TPS			SPECIFICATION : NUMBER : PE-TS-415-507-E006, R00			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER: PE-QP-999-507-E006, R0			SPECIFICATION TITLE	TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL		
	SHEET 5 OF 11		SYSTEM			ITEM : EPR INSULATED FIRE SURVIVAL CABLES			SECTION	VOLUME II		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.5	**Core Laying**	1. Dia over laid up core	MA	Measurement	One Sample of each size/ lot	IS 9968 Pt 1 & Approved datasheet	IS 9968 Pt 1 & Approved datasheet	Inpection Report	2	-	-	
		2. Sequence of lay & direction	MA	Visual & Meas.	-do-	IS 9968 Pt 1 & Mfs Std.	IS 9968 Pt 1 & Mfs Std.	-do-	2	-	-	
		3. Lay Length	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
2.6	**InnerSheath Extrusion**	1. Surface finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inpection Report	2	-	-	*(Pimple, fish eye, porosity & burnt particles not permitted.)*
		2. Thickness	CR	Measurement	One Sample of each size/ lot	Appd. Datasheet	Appd. Datasheet	-do-	2	-	-	
		3. Dia over inner sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-	
2.7	**Armour**	1. No.of wires/Strips	MA	Counting	At the start of the process	Mfrs Std. / Appd. Datasheet	Mfrs Std. / Appd. Datasheet	Inpection Report	2	-	-	
		2. Lay length & Direction	MA	Visual & Meas.	-do-	-do-	-do-	-do-	2	-	-	
		3. Dia over armouring	MA	Measurement	-do-	Appd. Datasheet	Appd. Datasheet	-do-	2	-	-	
		4. Coverage	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	

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

	STANDARD QUALITY PLAN		CUSTOMER : MAHARASHTRA STATE POWER GENERATION CO. LTD.			PROJECT TITLE 1 X 660MW BHUSAWAL TPS			SPECIFICATION : NUMBER : PE-TS-415-507-E006, R00			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER: PE-QP-999-507-E006, R0			SPECIFICATION TITLE			TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL
	SHEET 6 OF 11		SYSTEM			ITEM : EPR INSULATED FIRE SURVIVAL CABLES			SECTION			VOLUME II
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	AGENCY W	AGENCY V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.8	**Outer Sheath Extrusion (No repair permitted)**	1. Surface finish	MA	Visual	100%	Surface shall be smooth	Surface shall be smooth	Inpection Report	2	-	-	*(Pimple, fish eye, porosity & burnt particles not permitted.)*
		2. Sheath Thickness	CR	Measurement	One Sample of each size/ lot	Appd. Datasheet	Appd. Datasheet	-do-	2	-	-	
		3. Dia over outer sheath	MA	-do-	-do-	-do-	-do-	-do-	2	-	-	
		4. Embossing/ Sequencial Marking	MA	Visual	100%	-do-	-do-	-do-	2	-	-	
3.0	**Finished Cable (INTERNAL)**	**1. Routine Test (Refer Note-G)**	CR	Electrical Tests & Measurement	100%	IS 9968 Pt 1 & Approved datasheet	IS 9968 Pt 1 & Approved datasheet	Test Report	2	-	1	
4.0	**Final Inspection (EXTERNAL)**	**1. Finish**	MA	Visual	One drum in each Lot	IS 9968 Pt 1 & Approved datasheet	Free from Porosity, Bulging, Burnt particles,lumps, cuts & scratches	Test Report	2	1	-	
		2. Dimension	MA	Measurement	-do-	-do-	Approved Data Sheet	-do-	2	1	-	
		3. Armouring - Coverage No.of Wires	MA	Visual & Meas.	-do-	-do-	-do-	-do-	2	1	-	

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

	STANDARD QUALITY PLAN		CUSTOMER : MAHARASHTRA STATE POWER GENERATION CO. LTD.			PROJECT TITLE 1 X 660MW BHUSAWAL TPS			SPECIFICATION : NUMBER : PE-TS-415-507-E006, R00			
			BIDDER/ VENDOR :			QUALITY PLAN NUMBER: PE-QP-999-507-E006, R0			SPECIFICATION TITLE	TECHNICAL SPECIFICATION FOR EPR INSULATED FIRE SURVIVAL		
	SHEET 7 OF 11		SYSTEM			ITEM : EPR INSULATED FIRE SURVIVAL CABLES			SECTION	VOLUME II		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P	W	V	REMARKS
1	2	3	4	5	6	7	8	9	10			11
		4. Marking & Colour coding	MA	Visual	IS 9968 Pt 1 & Approved datasheet	-do-	IS 9968 Pt 1 & Approved datasheet	-do-	2	1	-	
		5. Acceptance Tests (Refer Note-G)	CR	Phy, Elect. Tests FRLS Tests	Sample #	-do-	-do-	-do-	2	1	-	
		6. Type Tests (Refer Note-G)	CR	Physical & Electrical Tests	Sample #	-do-	-do-	-do-	2	1	-	*# Refer Annexure to QAP enclsoed*
5.0	**Packing**	**End Sealing Identification / Polythene Packing**	MA	Visual	100%	Approved Datasheet	Approved Datasheet	-do-	2	1	-	

NOTES:-

(A) JOINTS IN WIRE SHALL BE AS PERMITTED BY IS / BHEL SPECIFICATION, VENDOR TO CERTIFY THE SAME.

(B) NO REPAIR OF CORE INSULATION PERMITTED.

(C) CABLE ENDS SHALL BE SEALED AS PER APPROVED DATASHEET.

(D) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER.

(E) FILLERS/DUMMY CORES ETC. SHALL BE AS PER APPROVED DATA SHEET

(F) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER BHEL SPECIFICATION.

(G) ***FOR LIST OF ROUTINE, TYPE & ACCEPTANCE TESTS, REFER ANNEXURE TO QAP ENCLOSED.***

(H) *WHEREVER THE EXTENT OF CHECK IS MENTIONED AS SAMPLE & NOT DEFINED IN QAP, THE SAMPLE SHALL BE AS PER VENDORS SAMPLING PLAN AGREED BY PURCHASER.*

(I) CABLE MANUFACTURER TO MAINTAIN RECORDS TO SHOW CO-RELATION OF RAW MATERIALS TO FINISHED CABLES I.E. RAW MATERIAL BATCH/ LOT NO. SHOULD BE TRACEABLE TO THE FINAL CABLE DRUM NUMBER OR BATCH NO.

(J) CABLE MANUFACTURER TO MAINTAIN ALL QUALITY RECORDS IDENTIFIED AS PER ALL QP STAGES ENUMERATED BELOW WHETHER IT IS IDENTIFIED FOR BHEL VERIFICATION OR WITNESS OR NOT.

(K) BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

(L) PHOTOGRAPHS OF CABLE TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW PRIOR TO ISSUE OF MDCC.

LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL/ CUSTOMER 2-VENDOR 3- SUB VENDOR CHP:CUSTOMER HOLD POINT WHICH WILL BE DECIDED AT CONTRACT STAGE

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

TYPE/ ACCEPTANCE/ ROUTINE TEST REQUIREMENTS

A. Type Test Conduction:

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

2. Sampling:
   a) Type test to be conducted on each type and size of cable, shall be carried out on one sample drum selected on random basis in each lot.
   b) FRLS & Flammability Test to be conducted only on one sample/ lot.
   c) Fire Survival tests at sl.no. 8 to be conducted on all sizes / lot.

B. Acceptance Test Conduction:

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

2. Sampling:
   Acceptance test (including FRLS & Flammability Test) to be conducted on 1 out 10 drums or less of every size for every lot.

C. Routine Test Conduction:

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

2. Sampling:
   Routine tests shall be conducted on 100% drums.

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
1.0	Tests for Conductor				
I.	Persulphate test	For copper conductor only	**T**	IS 10810 Pt 4	
II.	Annealing test	For copper conductor only	T, A	IS 10810 Pt 1	*Internal in process Test Report to be furnished for acceptance test*
III.	Conductor Resistance test	For Cu	T, A, R	IS 10810 Pt 5	
2.0	Tests for Armour Wires/Strips				
I.	Measurement of dimensions	Applicable for Copper wire & GS wire/Strip	T,A	IS 10810 Pt 36	

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S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
II.	Tensile test	Applicable for Copper wire & GS wire/Strip	T, A	AS PER RELEVANT IS / IS 10810 Pt 37	
III.	Elongation at break test	Applicable for GS wire/Strip only	T, A	IS 10810 Pt 37	
IV.	Torsion test	For GS round wire only	T, A	IS 10810 Pt 38	
V.	Winding test	For GS strip only	T, A	IS 10810 Pt 39	
VI.	Resistivity test	Applicable for Copper wire & GS wire	T, A,R	IS 10810 Pt 42	
VII.	Uniformity of Zinc coating test	For G. S. wires/Strip only	T, A	IS 10810 Pt 40	
VIII.	Mass of Zinc coating test	For G. S. wires/Strip only	T, A	IS 10810 Pt 41	
3.0	Test for Fire Barrier Tape				
I.	Test for minimum thickness	Fire barrier tape	T,A	IS 10810 Pt 6	
4.0	Physical Tests for EPR insulation & sheath				
I.	Material	Applicable for insulation, HOFR elastomeric inner & outer sheath	T,A	IS 9968 Pt 1	
II.	Test for thickness	Applicable for insulation, HOFR elastomeric inner & outer sheath	T,A	IS 10810 Pt 6	
III.	Tensile strength and elongation test at break	Applicable for insulation, HOFR elastomeric inner & outer sheath	T,A	IS 10810 Pt 7	
IV.	Ageing in air oven	Applicable for insulation	T	IS 10810 Pt 11	
V.	Ageing in air bomb	Applicable for insulation, HOFR elastomeric inner & outer sheath	T	IS 10810 Pt 56	
VI.	Hot set test	Applicable for insulation, HOFR elastomeric inner & outer sheath	T,A	IS 10810 Pt 30	
VII.	Oil resistance	Applicable for insulation, HOFR elastomeric inner & outer sheath	T	IS 10810 Pt 31	
VIII.	Tear resistance	Applicable for insulation, HOFR elastomeric inner & outer sheath	T	IS 10810 Pt 17	
5.0	Electrical Tests				
I.	Insulation resistance	Applicable for EPR insulation	T,A	IS 10810 Pt 43	
II.	High voltage (Water immersion) test	Applicable for HOFR elastomeric Inner & outer sheath	T,A,R	IS 10810 Pt 45	
III.	Water absorption test	Applicable for EPR insulation	T	IS 10810 Pt 28	

S. No.	TEST	APPLICABLE FOR	TEST CONDUCTION REQUIRED AS	REFERENCE STANDARD	REMARKS
6.0	HOFR Tests (On complete cable)				
I.	Oxygen Index test	Applicable for HOFR elastomeric Inner & outer sheath	T, A	ASTMD-2863	
II.	Temperature index test	Applicable for HOFR elastomeric Inner & outer sheath	T, A	ASTMD-2863	
III.	Smoke density test	Applicable for HOFR elastomeric Inner & outer sheath	T, A	ASTMD 2843	
IV.	Swedish chimney test	For complete cable	T, A	SEN SS 424 1475 (Class F3)	
V.	Acid Gas Generation test	Applicable for HOFR elastomeric Inner & outer sheath	T, A	IEC 60754-1	
7.0	Flammability Tests				
I.	Flammability test for bunched cables	For complete cable	T	IEC-60332 (Part-3) CAT-B	Refer Notes 1,2 & 3
II.	Flammability test for single cable	For complete cable	T	IEC:60332 Part-1	
III.	Flammability test	For complete cable	T	IEEE: 60383	
8.0	Fire Survival Test	For complete cable	T	IEC-60331	
9.0	Toxicity Index (max 5%)		T	NES 713	Acceptance Criteria: Material Certificate or availability of facility for conduction of test
10.0	Corrosive Gases Test (pH > 4.3 & conductivity < 100 microSiemens/cm)		T	IEC 60754-2	
11.0	Anti-rodent and Termite Repulsion test	For outer sheath only	T, A	Refer Note 4.	

Notes:

1. This test shall generally be carried out as per IEEE 383. The cable installation to be tested shall consist of as many cables as are necessary to give at least 10 kg of organic material per metre run.
2. The following cable installation shall be tested: Installation with single / multi core cables in touching formation.
3. Size of cables, number of cables, number of layers and laying arrangements for each installation shall be subject to BHEL / Customer's approval.

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

TYPICAL DRAWING OF CABLE DRUM PACKING