BSES

Technical Specification for

11 kV Cables

Conventional - 1CX1000, 3Cx400, 3CX300 and 3CX150 sqmm

Cable in Co-Extruded Duct – 3Cx400 & 3Cx300 sq mm

Specification No: BSES-TS-15-HTC-R0

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General Specification

1.0.0 Codes & Standards

The cables shall be designed, manufactured and tested in accordance with the following National Standards and IEC Standards.

National Standards

IS 7098 Part-2	Cross linked polyethylene (XLPE) insulated PVC sheathed cables for working voltages from 3.3 kV up to and including 33 kV.
IS 5831 : 1984	PVC insulation & sheath of electric cables.
IS 10810 : 1984	Methods of test for cables.
IS 8130 : 1984	Conductors for insulated electric cables and flexible cords.
IS 3975 : 1999	Mild steel wires, formed wires and tapes for armouring of cables.
IS 0462 (Part 1) / 1983	Fictitious Calculation Method for determination of dimensions of protective covering of cables

International Standards

IEC 60183	Guide to the selection of high voltage cables
IEC 60228	Conductors of insulated cables. Guide to the dimensional limits of circular conductors.
IEC 60332 – 3	Tests on electric cables under fire conditions. Part 3: Tests on bunched wires or cables.
IEC 60502 – 2	Power cables for rated voltages from 6 kV (Um = 7.2 kV) up to 30 kV (Um = 36 kV)
IEC 60811 Pts 1 through 5	Common test methods for insulating and sheathing materials of electric cables.
IEC 885 Pts 1 through 3	Electric test methods for electric cables.
IEC 28	International Standard of Resistance for Copper
IEC 332	Test on Electric Cables under fire conditions

2.0.0 Cable Construction Features

This Specification generally covers following types / sizes of TR-XLPE H. T. Cables used in BSES network in Delhi area, mostly under-ground (buried, with chances of flooding by water) or for laying on racks, in ducts, trenches, conduits, and so on.

Note: (Ref.: Table stating Cable sizes given below.)

Cable Code:

As per IS, cable designations comprise of following codes / options, as applicable for this Specification:

(N.A. - Not applicable for Specification)

-	(with Copper conductor)	(N.A.)
A	Aluminium conductor	

2X	XLPE insulation	

W	Steel round Wire armour	(N.A.)
WW	Double steel round Wire armour	(N.A.)
Wa	Non-magnetic round Wire armour	
F	Steel formed wire (strip) armour	
FF	Double steel formed wire (strip) armour	(N.A.)
Fa	Non-magnetic formed wire (strip) armour	(N.A.)
-	(“un-armoured” or without armour)	(N.A.)

Y	PVC outer sheath	

Sr. No.	Description	Conductor Material	Cable Code
1.	11 kV, 3c x 150 sq. mm.	Al	A 2X F Y
2.	11 kV, 3c x 300 sq. mm. (conventional)	Al	A 2X F Y
3	11 kV, 3c x 300 sq. mm. cable in co-extruded Duct	Al	A 2X F 2Y 2Y
4	11 kV, 3c x 400 sq. mm. (conventional)	Al	A 2X F Y
5	11 kV, 3c x 400 sq. mm. cable in co-extruded Duct	Al	A 2X F 2Y 2Y
6.	11 kV, 1c x 1000 sq. mm.	Al	A 2X Wa Y

Description of each item mentioned in the Specification (the text, BOQ, GTP or any site specific requirement) shall be followed, along with IS: 7098 – Part 2.

2.1.1	**Conductor**	a) Electrolytic Grade Stranded Aluminium Conductor b) Grade: H2 as per IS: 8130 / 1984 (For Al) c) Stranded, compacted and circular in shape d) Class 2 e) "Longitudinal Water-Blocking Arrangement" (or water-tight construction or water barrier protection) shall be provided within the Conductor. i) As per manufacturer's procedures, 100 % water-tight conductor shall be achieved. iii) Make & Type of materials to be used (i.e. Water-swellable tapes / yarn / powder, etc.) shall also be stated in the List of Sub-Vendors for pre-order approval. f) All detailed constructional features shall be shown in the cross-sectional drawing.
2.1.2	**Conductor Screen**	Extruded semi-conducting material. (Also refer Cl. 2.1.3.) (Tapes are not acceptable)
2.1.3	**Insulation**	a) Extruded XLPE (Cross-Linked Poly-Ethylene) Insulation, with water-tree retardant (WTR) property b) The required compound used shall be from BSES-approved sub-vendors and not from any other (refer Annexure – C). c) Uniform thickness of insulation shall be within

		the permissible values as per IEC Standards; eccentricity check shall be carried out to ensure this. d) Insulation Color : natural
2.1.4	**Insulation Screen**	a) Freely-strippable semi-conducting screen, which should not require application of heat for its removal. (Refer Cl. 2.1.3.) b) Text "Do not Heat - Freely Strippable" to be printed on insulation screen (at every 600 mm interval). c) Round shape over the outer semi-con shall be within the permissible limits as per IEC standards; Ovality (2% max) check shall be carried out to ensure this. d) Compound used shall be suitable for the operating temperature of the Cable and shall be compatible with the insulation used.
2.1.4A	**XLPE Process**	
2.1.4A-1	11 kV	Dry Cure and Dry Cool process only.
2.1.4A-2	Not in use	
2.1.4A-3	Extrusion	It is mandatory that Conductor Screen, Insulation and Insulation Screen shall be extruded simultaneously, in a Single One-Time Process (i.e. as a triple-head extrusion) to ensure homogeneity of layers over the conductor, and absence of voids.
2.1.4A-4	Make of Compounds for Insulation and Semi-conducting	Any deviation from Approved Makes mentioned in Annexure-C shall not be acceptable, unless the deviation has been specifically approved by BSES during tendering stage
2.1.5	**Water-Swell able Tape**	a) Semi-Conducting Water-Sellable Tape shall be provided, under the copper tape, on each core.

		b) Nominal thickness : 0.3 mm c) Weight: 118 gm / sq. m approx. d) Swell height: ≥ 12 mm in 1 min. e) Compatible to strippable / non-strippable semi-con, over which it is applied.
2.1.6	**Core Identification**	a) For 3-core cables, cores shall be identified by coloured strips (Red, Yellow, Blue), applied helically / longitudinally below the copper tape. The coloured strips shall carry the name of cable manufacturer permanently printed at 1 meter intervals; this is to provide additional identification of manufacturer of the cable.
2.1.6A	Copper Tape	Copper Tape shall be applied helically over the layer formed after application of insulation screen, water-swell able tape and identification strip. Zero negative tolerance in thickness of copper tape
2.1.7	**Filler**	a) All interstices, including center interstices shall be filled by PP filler. b) PP Filler shall be non-hygroscopic, not having any effect on other compounds used, stable at cable temperatures, etc. c) PVC filler is not acceptable. d) Filler is not applicable for single-core cables.
2.1.8	**Binder Tape**	As per manufacturer's standard
2.1.9	**Inner Sheath**	Extruded Inner Sheath of Black PVC type ST-2 (IS 5831)
2.1.10	**Armour**	a) For 3-core Cables : Galvanised Steel flat strip armour b) For 1-core Cables :

		Non-magnetic round wire armour (hard-drawn aluminium wire) c) Minimum area of coverage of armouring shall be 90 % (min.). At any time, the gap between any two adjacent armour strips / wires shall not be more than the width of strip / diameter of wire. d) Zero negative tolerance is for : • Thickness of armour strip • Diameter of armour wire
2.1.11	**Binder Tape**	Rubberised cotton tape
2.1.12	**Outer Sheath**	
2.1.12.1	**For Conventional cable**	a) Extruded outer sheath of PVC (ST-2 as per IS 5831) with termite-repellant and anti-rodent properties. Color - Blue (Outer Sheath shall be FRLS-type, if chosen by purchaser.)
2.1.12.2	**For 3Cx300 & 3Cx400 sq mm CCD cable (Cable in Co-extruded duct)**	a) Inner Layer- Extruded PE compound Type HDPE ST7 (Black)- Thickness 3.00 mm b) Outer Layer- Extruded PE compound Type HDPE ST7 ; Thickness 2 mm, color Orange (IS 557) or other color as per Tender requirement
		b) Shape of the cable over the outer sheath shall be circular, when manufactured / completed. Regular Ovality check shall be carried out at factory, to detect any abnormality. Manufacturing quality shall be such that cable will retain its circular shape, even after it is laid at site.
		c) The Outer Sheath shall be embossed as well as laser printed with following minimum text at a interval of 1 mtr: 1. The voltage designation 2. Type of construction / cable code

		(e.g. A2XFY) 3. Manufacturer's Name and Trade-mark 4. Number of cores and nominal cross-sectional area of conductor 5. Name of buyer / purchaser, 6. Month & Year of manufacturing 7. IS reference, i.e. IS : 7098 8. Batch No. / Lot No. (For traceability purpose, in case of any, in case of any manufacturing defect or otherwise arising in the cable in future.) 9. Purchase Order Number & date 10. Word ' FRLSH ', in case the cable is of FRLSH type. Note: a) Drum No. & Progressive (sequential) length marking shall be provided by Laser Printing at every meter with proper contrast in coloring b) Progressive length marking for every drum shall be starting from zero for every drum.
2.1.13	**Sealing-end Cap at both ends** (for Cables)	Cable both ends (inner and outer end) shall be sealed as per drawing MISC/E/4-1131/1698. One PVC cap with Polyurethane compound shall be provided as primary sealing and heat-shrink end-cap shall form a secondary sealing over the PVC cap.
2.1.14	**Pulling-eye Assembly at one end, Sealing-end cap at other end** (if required as per tender requirement)	A cable pulling-eye assembly as per Drg. No. MISC/E/4-1131/1698 shall be provided at the loose end (outer end) of the cable on each drum. Sealing material shall be filled in inside the spaces / gaps between the pulling-eye assembly and cable outer sheath. Further, a heat-shrinkable sleeve shall be provided over the pulling-eye assembly and outer

		sheath of cable. If pulling eye is required as per tender requirement, sealing end cap shall be required for only one end of cable.
3.0.0	(This number not used.)	
4.0.0	**Testing & Inspection**	Tests shall be carried out in accordance with IS 7098 (Part-2).
	a) Type Tests (IS 7098, IEC)	1) <u>To Qualify in Tender:</u> Cables must be of type tested quality. Type Test Reports shall be submitted for the type, size and rating of cable offered in the bid. For participation in the tender Type Test report shall be submitted from CPRI/ERDA only and shall not be more than 5 years old from the date of tender. If the report is more than 5 years and but less than 10 years old than bidder to submit undertaking that there is no design changes from the Type test conducted. 2) <u>Type Test Required After Award of PO:</u> Type test on one cable drum of each type/rating from any lot shall be conducted at CPRI/ERDA on sample basis as per relevant IS/IEC. Sample shall be sealed by BSES during inspection of cable. This type test is applicable subject to BSES requirement and cost shall be borne by BSES.
	b) BSES QAP (Typical)	In general, all tests mentioned in the BSES QAP (Characteristics – Typical) mentioned in Annexure-F shall be included in the Routine Tests, Type Tests and Acceptance Tests stated above.
	c) Routine Tests	1. Measurement of Electrical Resistance 2. HV Test with power frequency AC voltage 3. Partial Discharge test 4. “Strippability Test” at both the ends of cable for each drum, to check the freely-strippable

		property of the Insulation Screen (outer semi-con). 5. Impulse voltage test of one drum 6. Armour coverage measurement 7. Physical test-Dimensions of each and every layer and components. Test results from the above tests must appear in the documents forwarded by the vendor for Inspection call / waiver.
	d) Inspection	1. The Buyer reserves the right to witness all tests specified on completed cables. 2. The Buyer reserves the right to inspect cables at Sellers works at any time prior to dispatch, to verify compliance with the specifications. 3. In-process (stage inspection) and final inspection call intimation shall be given at 10 days advance to the purchaser along with complete manufacturing scheduled. 4. Minimum lot size of Cables to be offered for inspection shall be mutually agreed between Purchaser and Vendor, before placing the order. Vendor shall raise inspection call only after a minimum lot size is ready and with due factory routine tests already carried out.
	e) Acceptance Tests	Acceptance Tests shall be conducted as per Cl. 18.2 of IS 7098 (Part-2) and the approved Quality Assurance Plan (QAP) for each lot of cables. Following tests shall also be carried out during the Acceptance Tests : a) "Wafer Boil Test" for checking integrity of semi-conducting layers-in each lot. b) "Void-and-contamination Test" for the Insulation-in each lot c) "Strippability Test" at both the ends of cable for each drum, to check freely-strippable property of

		the Insulation Screen (outer semi-con) - in each lot. d) "Water Penetration Test (WPT)", as per applicable IEC standards, to check adequacy of water-blocking arrangement provided inside the conductor -in each lot. e) Impulse voltage test – in each lot sample basis. f) Heating Cycle along with potential once per PO on sample basis.
	f) Test Certificates (TC)	Three sets of complete Test Certificates (Routine tests and Acceptance tests) shall be submitted along with the delivery of cables. Soft copy of the TCs shall be separately e-mailed to the Purchaser. **Note :** Make/grades of critical materials (such as, for conductor screen, insulation, insulation screen, etc.), actually used during manufacturing of cables for order-on-hand, shall be clearly stated in the TCs forwarded by the Manufacturer, enabling references in future.
5.0.0	**Drawing, Data and Manuals**	a) Refer Annexure-A regarding Document Submission. b) Cross-Sectional Drawing shall show every feature of construction, including the thickness / diameter over every layer. This drawing shall also state the text to be embossed over the outer sheath - i.e. type/size, etc. of the cable, drum no./lot no., sequential marking over every meter, printing text on outer semi-con ("Do Not Heat-Freely Strippable"), font sizes to be used, additional text, if any, etc. Also, drum details, markings to be made on both sides of the drum, and so on.

5.0.1	Documents to be submitted along with bid	The vendor shall submit : a) Cross-sectional drawing b) GTP (all data to appear) c) Type Test certificates d) Fault Level Calculation for armour and copper tape screen e) Complete Cable Catalogue and Manual f) Armour Coverage Calculation g) Raw materials make list
5.0.2	Documents after award of contract	Within 15 days, the seller has to submit four sets of above-mentioned drawings, along with one soft copy for buyer's approval.
5.0.3	Final As-Built Drawings	One soft copy of all documents, including type & routine test certificates.
6.0.0	**Drum length & tolerance**	Cable length per drum
6.0.1	a) 11 kV, 3Cx150 sqmm b) 11kV , 3Cx300 sqmm c) 11 kV, 1Cx1000 sqmm d) 11kV , 3Cx400 sqmm	300 mtr +/- 5% or 500 mtr +/- 5% (100% of the ordered quantity) as per tender requirement
6.0.2	Overall tolerance	- 2 % for the total cable length for the entire order.
6.0.3	Short length of cables	Manufacturer shall take prior approval from Purchaser for any supply of short length cables. For 11 kV cables, minimum acceptable short length cables can be 250 meter. In any case, manufacturer shall not put two cable pieces of different short lengths in same cable drum.

		Only one short length drum shall be accepted and in last lot only.
7.0.0	**Packing, Shipping, Handling & Storage**	
	a) Packing	a) Both the ends of the cables shall be properly sealed to prevent any deterioration of the cable, due to ingress of water, etc. b) Cable inner end (starting end) shall project, outside the completely wound cable, by sufficient length enabling verify cable details, including the initial length marking. c) Similarly, outer end of the cable shall be saddled / secured to the drum properly to prevent any external damage to the end at any time. d) Before putting on wooden planks, protective covers (thick plastic sheets, etc.) shall be secured over the wound cable, to avoid any abrasion by wooden planks, over the outer sheath of the cable. e) After providing the protective covers, the cable drums shall be finally closed by wooden planks (with saddles), without leaving any gaps between the planks; i.e. 100 % covering shall be ensured.
	b) Drum Identification Markings:	Direct marking (i.e. text painting through stencils, etc.) shall be done on the drums, instead of attaching labels, which may be misplaced/lost over a period of time. a) Drum identification number b) Cable voltage grade c) Cable code (e.g. A2XFY, etc.) d) Number of cores and cross sectional area e) Cable quantity, i.e. cable length (meter)

		f) Purchase order number & date g) SAP item code h) Total weight of cable and drum (kg) i) Manufacturer's Name j) Buyer's name k) Month & Year of Manufacturing l) Direction of rotation of drum m) Cable length final end-markings (i.e., reading at the inner end and reading at the outer end, just before packing, shall be marked on the drum.)
	c) Shipping information	The seller shall give complete shipping information concerning the weight, size of each package
	d) Transit damage	The seller shall be responsible for any transit damage due to improper packing.
	e) Type of Drum	Wooden or Steel drums as per tender requirement (all the drums shall be non returnable except otherwise mentioned in the tender), as per relevant IS / IEC.
	f) Cable Drum handling	The drums shall be with M.S. spindle plate (with nut-bolts) of adequate size to suit the spindle rods, normally required for handling the drums, according to expected weight of the cable drums.
8.0.0	**Quality Assurance Plan (QAP)**	
8.0.1	Vendor's QAP	Manufacturer shall submit QAP in line with BSESQAP (Annexure-F) for purchaser's approval before starting of manufacturing which is mandatory
8.0.2	Inspection Points	As per BSES approved QAP and special BSES requirement if any to cross check the product quality. Seller must have to meet the special requirement of BSES during inspection.
9.0.0	**Progress Reporting**	

9.0.1	Outline Document	To be submitted for purchaser's approval for outline of programmes for production, stage-inspection, testing, final inspection, packing, dispatch and documentation.
9.0.2	Detailed Progress Report	To be submitted to Purchaser once a month containing : i) Progress on material procurement ii) Progress on fabrication (as applicable) iii) Progress on assembly (as applicable) iv) Progress on internal stage-inspection v) Reason for any delay in total programme vi) Details of test failures, if any, during manufacturing stages. vii) Progress on final box-up Constraints / Forward Path
10.0.0	**Deviation**	a) Deviations from this specification shall be listed separately by bidder clause wise (format given in Annexure- H) along with optional offer and has to submit the list along with bid/quotation. BSES will review the deviations and if BSES is agreed with the deviation, seller has to take written confirmation from BSES on deviation during tender evaluation. b) In the absence of any separate list of deviations from the bidders with bid as well as written confirmation from BSES on deviations, it will be assumed by the Buyer that the Seller complies with the Specification fully. c) Any deviations mentioned in any other submitted bid documents (i.e.in filled GTP, Catalog, BSES old approval, buyer's/seller's standards etc.) by seller without separate deviation sheets will not consider as a deviation from this tech spec at any stage of contract.

Annexure – A

Scope, Documentation and Delivery schedule

Document/Drawing submission shall be as per the matrix given below:

a. All documents/drawings shall be provided in soft copy only in returnable Pen drives
b. Language of the documents shall be English only.
c. Incomplete submission shall be liable for rejection.
d. Document check sheet compliance shall be the first sheet for each submission stage i.e. Technical bid, Drawing Approval, Pre Dispatch, Pre closure
e. No submission is acceptable without check list compliance.
f. Deficient/ improper document/ drawing submission shall be liable for rejection.
g. Order of documents shall be strictly as per the check list.
h. Any document not included in the below table but necessary for detailed engineering shall be deemed to be included in bidder's scope

S.No.	Detail of Document	For Tender	For Approval/Review	Final Submission
1	Guaranteed Technical Particulars (GTP)	Required	Required	Required
2	Deviation Sheet, if any	Required	Required	Required
3	Detailed cross sectional drawing of cable and drum	Required	Required	Required
4	Installation Instructions		Required	Required
5	Manual/Catalogue	Required	Required	Required
6	Cable de-rating factors		Required	Required
7	Type test reports of offered type and rating of cable	Required	Required	Required
8	BIS certificate	Required		
9	Make of Raw Materials	Required	Required	Required
10	Inspection and test reports, carried out in manufacturer's works			Required
11	Routine Test Certificates			Required
12	Test certificates of all the raw materials			Required

Annexure - B

GUARANTEED TECHNICAL PARTICULARS (GTP)

Note:

1) For every type / size of cable, every data shall be mentioned.
2) Seller may submit separate GTP for every type / size of cable, as suitable.
3) GTP requirements are generally as per IS: 7098 (Part-II).
4) GTP shall be read in line with purchaser's Project Site Specific Requirement.

Sr. No.	Description	Buyer's requirement	Unit	Seller's Data
1.0	Purchase Req. No.	-		
2.0	Guarantee Period (Min.)	60 Months (from date of commissioning) / 66 Months (from date of receipt at purchaser's store) whichever is earlier		
3.0	Applicable IS / IEC Standard followed by vendor	IS 7098 Part-2 / IEC 60502-2		
4.0	Make	-		
5.0	**Type** (as required by purchaser)			
	a) 11 kV, 3c x 150 sq. mm.	A2XFY		
	b) 11 kV, 3c x 300 sq. mm.	A2XFY		
	c) 11 kV, 3c x 300 sq. mm. CCD	A2XF2Y2Y		
	d) 11 kV, 3c x 400 sq. mm.	A2XFY		
	e) 11 kV, 3c x 400 sq. mm. CCD	A2XF2Y2Y		
	f) 11 kV, 1c x 1000 sq. mm.	A2XWaY		
6.0	**Voltage Grade**			
	a) 11 kV, 3c or 1c	6.35 / 11	kV	
7.0	Maximum Conductor temperature			
A	Continuous	90	deg. C	
B	Short time	250	deg. C	
8.0	**Conductor**	Compacted, Circular, Water tight construction is mandatory		

Technical Specification for 11 kV Cables (1CX1000,3Cx400, 3CX300 and 3CX150 sqmm)

A	Material and Grade	As per Cl. 2.1.1		
B	Size	As shown under 5.0 above		
C	Wires in each conductor	As per Table 2 of IS 8130	Nos.	
D	Conductor Shape	As per Cl. 2.1.1 c		
E	Dia. of wires in each conductor before compaction	Manufacturer Standard	Mm	
F	Diameter over conductor		Mm	
G	Maximum Conductor resistance at 20 ° C			
	a) 11 kV, 3c x 150 sq. mm.	0.2060	ohm/km	
	b) 11 kV, 3c x 300 sq. mm.	0.1000	ohm/km	
	c) 11 kV, 3c x 400 sq. mm.	0.0778	ohm/km	
	d) 11 kV, 1c x 1000 sq. mm.	0.0291	ohm/km	
H	Longitudinal Water Blocking Arrangement within conductor	Is it provided and shown in the cross-sectional drawing? (Yes / No)		
I	Short circuit current-carrying capacity of conductor		kA for 1 sec.	
9.0	**Conductor Screen** (inner semi-con)			
A	Material & type	As per Cl. 2.1.2		
B	Thickness (min)	0.50	Mm	
C	Diameter over conductor screen		Mm	
D	Make and grade of semi-conducting compound			
10.0	**Insulation**			
A	Insulation Material	As per Cl. 2.1.3		
B	Nominal thickness			
	a) 11 kV, 3c or 1c	3.6	Mm	
C	Minimum thickness			
	a) 11 kV, 3c or 1c	3.14	Mm	
D	Diameter over Insulation		Mm	
E	Make and grade of Insulation compound			
F	Eccentricity	As per IEC standards	%	
G	Water-tree retardant property	Required		
11A.	**Insulation Screen** (outer semi-con)			
a.	i) Thickness of freely strippable Semi conducting screen	0.50	Mm	
	ii) Make and grade of semi-conducting compound			
	iii) Printing	As per Cl. No. 2.1.4 (Yes / No)		

	iv) Ovality of the core (max)	2	%	
b.	Diameter over Insulation Screen (approx.)		Mm	
11B.	**Water-Swellable Tape** (if required by Purchaser)			
	a) Thickness b) Weight c) Swell height d) Compatible to strippable / non-strippable semi-con, over which it is applied. e) Make & Grade f) Pre-slitted packed tapes from sub-vendors approved by BSES	a) 0.3 mm b) 118 gm / sq. m c) ≥ 12 mm in 1 min. d) Yes / No e) Pl. state f) Yes / No		
11C.	**Cable Core identification** a) By coloured strips over cores applied helically / longitudinally b) Manufacturer's name shall be permanently printed on the strips, at close intervals.			
11D.	**Copper Tape**			
	i) Dimensions	a) Thickness : 0.06 + 5 % b) Width : 50 mm C) Overlap: 10% d) no negative tolerance in thickness of copper tape	Mm	
	ii) Fault current-carrying capacity of copper tape	Manufacturer's Standard (Calculation sheet shall be attached)	… kA for … sec.	
11E.	Diameter over laid up core (approx.)		Mm	

Technical Specification for 11 kV Cables (1CX1000,3Cx400, 3CX300 and 3CX150 sqmm)

12.0	**Filler** (Material and type)	As per Cl. 2.1.7 (Specify no. & size of filler at center & core interstices)		
	a) 11 kV, 3c x 150 sq. mm.			
	b) 11 kV, 3c x 300 sq. mm.			
	c) 11 kV, 3c x 400 sq. mm.			
	d) 11 kV 1core	Not applicable		
12A.0	**Binder Tape**	over laid-up cores		
13.0	**Inner Sheath**			
A	Material and type	As per Cl. 2.1.9		
B	Minimum thickness			
	a) 11 kV, 3c x 150 sq. mm.	0.6	Mm	
	b) 11 kV, 3c x 300 sq. mm. (conventional & CCD)	0.7	Mm	
	c) 11 kV, 3c x 400 sq. mm. (conventional & CCD)	0.7	Mm	
	d) 11 kV, 1c x 1000 sq. mm.	0.7	Mm	
C	Approx. dia. over inner sheath		Mm	
14.0	**Armour**	as per purchaser's requirements		
A	Material			
	a) 11 kV, 3c	G. I. Strip	No.	
	b) 11 kV 1c	non-magnetic wire armour (Aluminium wire)	No.	
B	Armour – Wires a) Diameter of wire b) Number of wires (min.)	As per Table 6 of IS 7098 Part-2 (zero negative tolerance for diameter)	mm. no.	
C	Armour – GI strips a) Width of strip & Thickness of strip b) Number of strips (min.)	a) 6.1 x 1.4 (zero negative tolerance for thickness) b) Vendor to specify	mm no.	
D	Approx. Equivalent Area		sq. mm.	
E	Area covered by armour	Min. 90 % Calculation shall be attached.	%	
F	Dia. over armour - approx.		Mm	
G	Fault current carrying capacity of armour	Calculation sheet shall be attached.	… kA for … sec.	
15.0	**Outer Sheath**			
A	Material and type	As per Cl. 2.1.12		

B	Thickness (min.)	** As per Table-5 of IS 7098 Part-2		
	a) 11 kV, 3c x 150 sq. mm.	**	mm	
	b) 11 kV, 3c x 300 sq. mm. Conventional cable	**	mm	
	c) 11 kV, 3c x 400 sq. mm. Conventional cable			
	d) 11 kV, 1c x 1000 sq. mm.	**	mm	
	e) 11 kV, 3c x 300 sq. mm. CCD cable	As per Cl. 2.1.12		
	f) 11 kV, 3c x 400 sq. mm. CCD cable			
C	Color	As per Cl. 2.1.12		
D	Embossing (details as per Cl. 2.1.12)	Yes		
E	FRLS Properties	As per customer's requirement		
16.0	Approx. overall diameter		mm	
17.0	Standard drum length with tolerance			
	a) 11 kV, 3Cx150 sqmm b) 11kV , 3Cx300 sqmm conventional or CCD c) 11kV , 3Cx400 sqmm conventional or CCD d) 11kV , 1Cx1000 sqmm	500 mtr +/- 5% or 300 mtr +/- 5%	meters	
17A	Overall order tolerance-~~{R1}~~	- 2 % for the total cable length for the entire order.		
18.0	**Cable Drum**			
a.	Type of drum	Wooden/ Steel non returnable (Specify the relevant IS / IEC followed for drum design)		
b.	Markings on the drum (as per Cl. 7.0.0)	On both faces		
18A.0	**Cross-Sectional Drawing** (ref. Cl. 5.0.0)	Is drawing submitted, showing every feature of constructions?		

		(Yes / No)		
19.0	a. Sealing-end Cap (provided at the both Ends)	Yes/No Is manufacturer's / Sub-Vendor's drawing submitted? (Yes / No)		
	b. Pulling Eye at one end and Sealing-end Cap provided at other end	Yes/No Is manufacturer's / Sub-Vendor's drawing submitted? (Yes / No)		
20.0	**Weights**			
	a) Net weight of cable (approx.)		kg / km	
	b) Weight of empty drum	500 mtr/300 mtr	Kg	
	c) Weight of Cable with drum	500 mtr/300 mtr	Kg	
	d) Size of Drum	500 mtr/300 mtr	mm	
	e) Drawing of Drum	Required	EA	
21.0	Continuous current rating for standard I. S. condition laid Direct			
	a) In ground 30° C		Amp	
	b) In duct 30° C		Amp	
	c) In air 40° C		Amp	
22.0	(not used)			
23.0	Electrical Parameters at Maximum Operating temperature:			
A	AC Resistance		ohm / km	
B	Reactance at 50 c/s		ohm / km	
C	Impedance		ohm / km	
D	Zero sequence impedance		ohm / km	
E	Positive sequence impedance		ohm / km	
F	Negative sequence impedance		ohm / km	
G	Capacitance		micro-farad / km	
H	Conductance		Amperes per volts	
I	Inductive susceptance		mho	
J	Capacitive susceptance		ohms	
24.0	Recommended minimum bending radius	12 x O. D.	mm	

Technical Specification for 11 kV Cables (1CX1000,3Cx400, 3CX300 and 3CX150 sqmm)

25.0	De-rating factor for following Ambient Temperatures :	Ground / Air		
	a) At 30° C			
	b) At 35° C			
	c) At 40° C			
	d) At 45° C			
	e) At 50° C			
26.0	Group factor for following numbers of cables laid :	Touching Trefoil		
	a) 3 Nos.			
	b) 4 Nos.			
	c) 5 Nos.			
	d) 6 Nos.			
27.0	Recommended pressure for laying cable using power winch	30 N / mm2	N / sq. mm.	
28.0	Process of Cross-linking of Polyethylene			
	a) 11 kV, 3c or 1c	Dry Cure process and Dry Cooling only		
29.0	**Type test** (TTR - Type Test Report)	Is copy of latest valid TTR for respective sizes enclosed? (Yes / No)		
30.0	**Quality Assurance Plan** (QAP)	Is QAP Format (Annexure-F), duly filled in and enclosed? (Yes / No)		
31.0	**List of Sub-Vendors** for construction items (Annexure-C)	Is this list enclosed for BSES approval? (Yes / No)		

Annexure - C

List of Sub-Vendors for critical items

Vendor/Bidder to state sub-vendors' names for other items, wherever approved names are not mentioned, for purchaser's approval during tendering stage else purchaser shall impose as per their requirement and bidder to follow the same in post-order stages.

Ser. No.	Raw Materials		Name of the Make
1.	XLPE Compound	1	Dow Chemicals , U.S.A.
		2	Borealis , Sweden
		3	Hanwha , South Korea
2.	Semi-Conducting Compound	1	Dow Chemicals, U.S.A.
		2	Borealis , Sweden
		3	Hanwha , South Korea
3.	Conductor Water-Blocking tapes / yarn	1	Lantor
		2	Geca
		3	Miracle
		4	Scapa
		5	Sneham International
4.	Water-Swellable Tapes (Pre-slitted)	1	Lantor
		2	Geca
		3	Miracle
		4	Scapa
		5	Sneham International
5.	Aluminium Rod	1	Bharat Aluminium Co. Ltd. (BALCO)
		2	Hindustan Aluminium Co. Ltd. (HINDALCO)
		3	National Aluminium Co. Ltd. (NALCO)
		4	Vedanta (Sesa Sterlite)

Ser. No.	Raw Materials		Name of the Make
6.	Copper Tape	1	Aggarwal Metal
		2	Indian Smelting
		3	Luvata Swedan
		4	Outokumpu Copper Strip AB, Swedan
7	Galvanised Steel Wires / Strips	1	Tata
		2	Balaji
		3	Systematic
		4	Mica Wires Pvt. Ltd.
		5	Bansal Industries
8	PVC Compound	1	Kalpana
		2	Universal
		3	SCJ Plastic
		4	Sriram Polytech
		5	Shri Ram Vinyl, Kota
9	P. P. Fillers	1	Vijoy Polymers
		2	Yash Polymers
		3	AVSL Industries
10	Core Identification Tape	1	AVSL Industries
		2	Yash Polymer
		3	Vijoy Polymers
11	PE Compound	1	Borealis
		3	Shakun
		4	Kalpana

Annexure - D

Service Conditions

(Atmospheric / Soil conditions at Site)

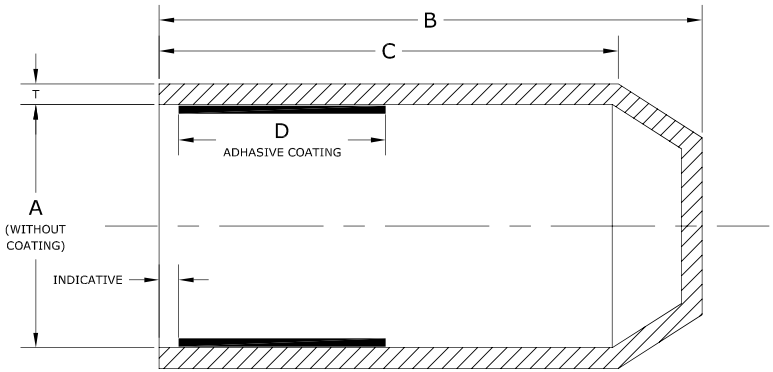
B.	**Delhi**	
a)	Average grade atmospheric condition	Heavily polluted, dry
b)	Maximum altitude above sea level	1000 M
c)	Air temperature Ambient	i) Highest : 50 deg C ii) Average : 40 deg C iii) Minimum : 0 deg C
d)	Relative Humidity	100 % max
e)	Thermal Resistivity of Soil	150 deg. C. cm / W max.
f)	Seismic Zone	4
g)	Rainfall	750 mm concentrated in four months

ANNEXURE E

DIMENSIONS

SIZE	A EXP.(Min.)	A REC.(Max)	B EXP.(Min.)	C EXP.(Min.)	D EXP.(Min.)	LC %	T (WALL REC. ± 20 %)
EC 120/150	75	34	120	105	50	± 10	4.2
EC 240/300	100	62	130	110	70	± 10	3.5
EC 400	145	75	155	120	70	± 10	4.6

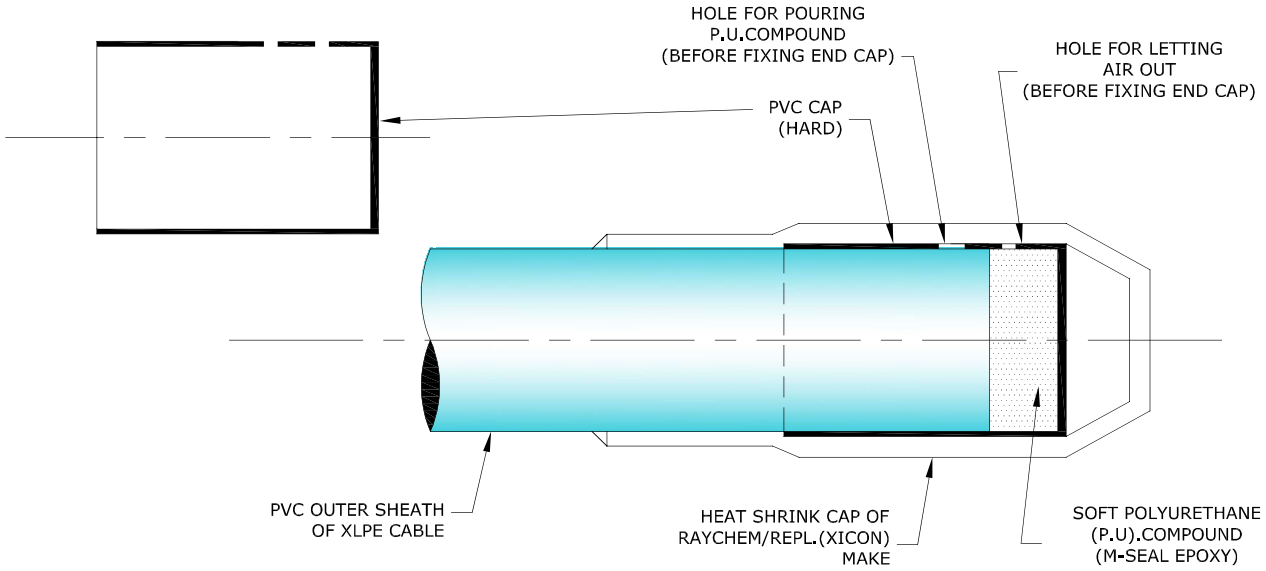
EXP - Expanded (as supplied), REC - Recovered freely, LC - Longitudinal Change,T - Wall Thickness, EC - End Cap



END CAP
(AS SUPPLIED)
SECTIONAL VIEW

MATERIAL SPECIFICATIONS

	Characteristics	Test Class	Value	Test Method
A	**Physical Properties**			
1	Specific Gravity	Type	1.05 ± 0.2	ASTM D-1505
2	Water Absorption	Type	1 % (max)	ASTM D-570 / ISO 62
3	Tensile Strength	Routine	10 N /sqmm (min)	ASTM D-412 / ISO 37
4	Ultimate Elongation	Routine	300% (min)	ASTM D-412 / ISO 37
5	Hardness	Type	45 shore D ± 3	ASTM D-2240
6	**Thermal Test**			
B	Thermal Ageing (120°C for 500 hrs)			
1	Tensile Strength	Type	8 N/sqmm (min)	ASTM D-412 / ISO 37
2	Ultimate Elongation	Type	200% (min)	ASTM D-412 / ISO 37
C	**Electrical Properties**			
1	Volume Resistivity	Type	10^{12} ohm-cm. (min)	ASTM D-257 / IEC 93
2	Dielectrical Strength	Type	10 kV/mm. (min)	ASTM D-149 / IEC 243
3	Dielectric Constant	Type	5 (max)	ASTM D-150 / IEC 250



END CAP
(AFTER HEAT SHRINKING OVER THE CABLE END)

Note : 1) All dimension in mm
2) Colour Black
3) Size as mentioned in the table shall be stencilled on respective item

BSES

DRAWING No. MISC/E/4-1131/1698

SCALE :NOT TO SCALE | DATE: 09-05-2011

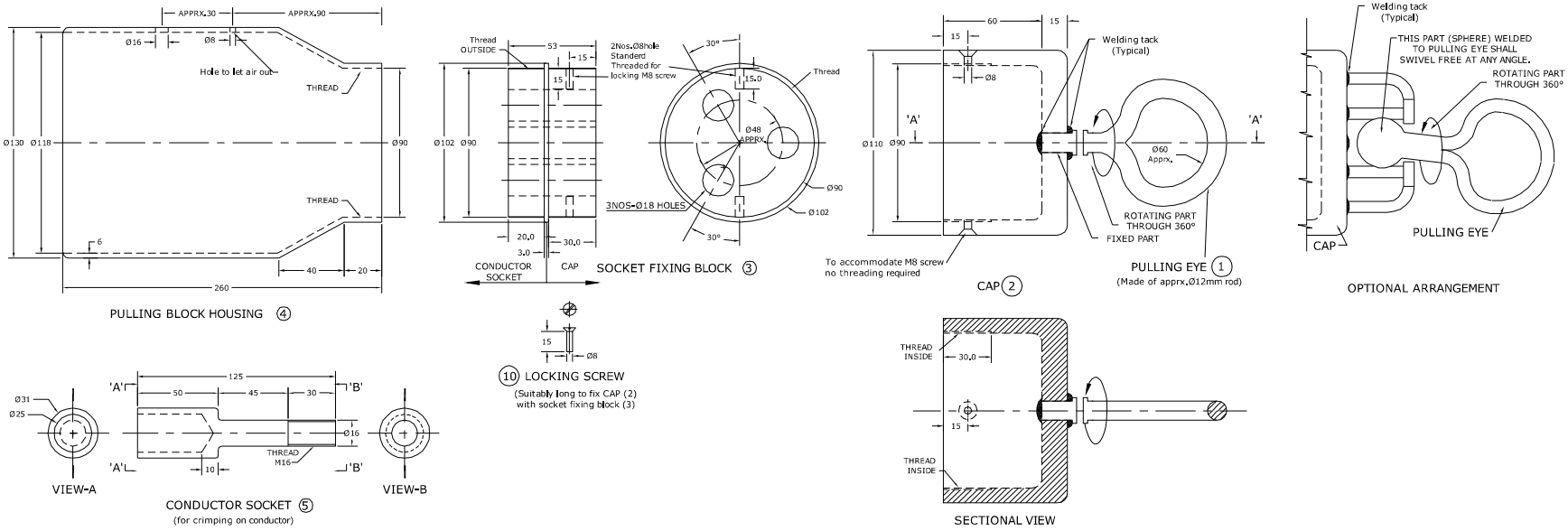
END SEALING CAP
(FOR XLPE CABLE)

DRAWN BY: | CHECKED BY: | APPROVED BY:

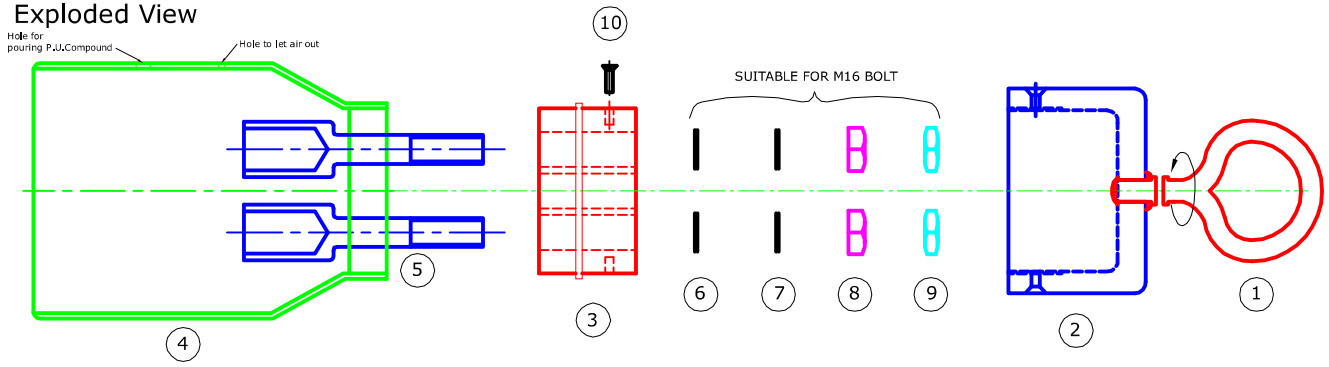
REVISIONS

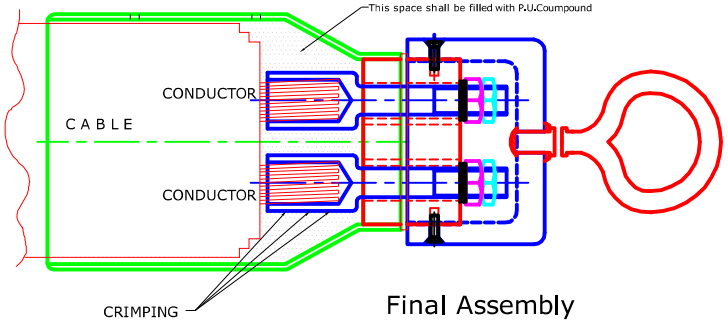
Addl V.P.

ANNEXURE F



Exploded View





Final Assembly

EXAMPLE:
1) For cable size 33kV, 3/C X 400sq mm Al XLPE.
2) Diameter over conductor : 23.8mm apprx.
   Overall diameter : 108±3mm apprx.
   Pulling force applicable on the cable : 30 N/sq mm
   Pulling eye shall withstand total force of : 36000N+Safety margin

NOTE:
1) All Dimensions are in mm, unless otherwise stated.
2) This drawing is typical / indicative.Separate dimensioned drawing for cable pulling eye assembly, suitable for required size & rating of cables, shall be submitted for approval,prior to manufacturing.
3) After fixing cable pulling eye, P.U.(Poly-Urethane) Compound shall be poured to occupy inner spaces to avoid ingress of Water / Moisture.
4) After P.U.Compound oozes/flows out from the cable side,the same edge shall be sealed with suitable sleeve/Tape.

NO.	DISCRIPTION	QTY.	MATERIAL
10	LOCKING SCREW	2	M.S.Zinc-Plated
9	LOCK NUT	3	M.S.Zinc-Plated
8	NUT	3	M.S.Zinc-Plated
7	SPRING. WASHER	3	M.S.Zinc-Plated
6	PLAIN WASHER	3	M.S.Zinc-Plated
5	CONDUCTOR SOCKET	3	AL.
4	PULLING BLOCK HOUSING	1	M.S.Zinc-Plated
3	SOCKET FIXING BLOCK	1	M.S.Zinc-Plated
2	CAP	1	M.S.Zinc-Plated
1	PULLING EYE	1	M.S.Zinc-Plated

BSES

DRAWING No. MISC/E/4-1133/1699

SCALE :NOT TO SCALE | DATE: 09-05-2011

CABLE PULLING EYE ASSEMBLY (TYPICAL)

DRAWN BY: | CHECKED BY: | APPROVED BY:

REVISIONS

Addl V.P.

BSES

ANNEXURE G : QUALITY ASSURANCE PLAN (QAP)

FOR 11 kV H. T. CABLES

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			Remark
									SV	MFR	BSES	
1	2	3	4	5	6	7	8	9	10	11	12	13
	Legend : SV : Sub-Vendor of Cable Manufacturer, MFR : Cable Manufacturer, MPS : Material Purchase Specification,											
	P : Perform, W : Witness, V : Verification											
A	**RAW MATERIAL**											
1	Aluminium/Copper Rod	a) Tensile strength	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		b) Resistivity	Major	Electrical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		c) Diameter	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		d) Chemical composition	Major	Chemical	Sample	MPS	MPS	Test certificate	P	V	V	
		e) Surface finish	Major	Visual	Sample			-	P	P	_	
2	PVC Compound	a) Tensile Strength	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		b) Elongation at break	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		c) Thermal stability	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
3	**TR-XLPE** Compound (Borealis/Dow chemical/ Hanwa)	a) Packing	Minor	Visual	100%	MPS	MPS	-	P	V	-	
		b) Tensile Strength	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		c) Elongation at break	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		d) Hot set test	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		e) Volume Resistivity	Major	Electrical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		f) Cure Curve (Max. Torque)	Major	Physical	Sample	MPS	MPS	Reg./Sheet	-	P	V	
		g) Density	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
4	Semi-conducting Compound (Borealis/Dow chemical/ Hanwa)	a) Packing	Minor	Visual	100%	MPS	MPS	-	P	V	-	
		b) Volume Resistivity	Major	Electrical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		c) Tensile Strength	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		d) Elongation at break	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		e) Cure Curve (Max. Torque)	Major	Physical	Sample	MPS	MPS	Reg./Sheet	-	P	V	
		f) Density	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
5	Copper tape	a) Thickness & width	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		b) Tensile Strength	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		c) Elongation at break	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		d) Resistivity	Major	Electrical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
6.	Armour wires/strips (Galvanised steel)	a) Dimensions	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		b) Surface condition/finish	Major	Visual	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		c) Tensile Strength	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		d) Elongation at break	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		e) Torsion test for round wire	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		f) Wrapping test	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		g) Mass of zinc coating	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		h) Uniformity of zinc coating	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		i) Adhesion test	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		j) Resistivity test	Major	Electrical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
7	Water Swellable	a) Dimensions	Minor	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	

BSES

ANNEXURE G : QUALITY ASSURANCE PLAN (QAP)

FOR 11 kV H. T. CABLES

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			Remark
									SV	MFR	BSES	
1	2	3	4	5	6	7	8	9	10	11	12	13
	Legend : SV : Sub-Vendor of Cable Manufacturer, MFR : Cable Manufacturer, MPS : Material Purchase Specification,											
	P : Perform, W : Witness, V : Verification											
	tape	b) Swelling height	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		c) Resistivity	Major	Electrical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
		d) Weight	Major	Physical	Sample	MPS	MPS	Reg./Sheet	P	P/V	V	
8	Steel Drum	a) Dimension	Major	Meas.	1 sample per size	IS 10418 / Purchase order		-	P	P	-	
		b) Finish & workman ship	Minor	Visual	1 sample per size	Compliance to standard Engineering norms & free from surface defects		-	P	P	-	
9	Binder tape	a) Dimensions & material	Minor	Physical	Sample	MPS	MPS	-	P	P	-	
10	Polypropylene filler	a) Size	Minor	Physical	Sample	Purchase order	Purchase order	-	P	P	-	
11	Heat shrinkable end cap	a) Bore diameter	Major	Physical	1 sample per size	--	--	-	-	P	-	
		b) Length of end cap	Minor	Physical	1 sample per size	--	--	-	-	P	-	
B	**PROCESS INSPECTION**											
1	Wire Drawing	a) Diameter	Major	Physical	Sample			Reg./Sheet	-	P	V	
		b) Surface finish	Major	Visual	100 %	Smooth & free from defects		--	-	P	-	
		c) Tensile test (for Al)	Major	Physical	Sample	IS: 8130/84	IS: 8130/84	Reg./Sheet	-	P	V	
		d) Elongation test (for Cu)	Major	Physical	Sample	IS: 8130/84	IS: 8130/84	Reg./Sheet	-	-	V	
		e) Wrapping test (for Al)	Major	Physical	Sample	IS: 8130/84	IS: 8130/84	Reg./Sheet	-	P	V	
2	Stranding	a) No. of wires/strands	Major	Physical	At the time of m/c setting			Reg./Sheet	-	P	V	
		b) Lay length & Lay direction	Major	Physical	-do-			-	-	P	V	
		c) Dia of conductor	Major	Physical	During setting & once in each shift			Reg./Sheet	-	P	V	
		d) Surface finish	Major	Visual	100 %	No surface defects and free from sharp edges, scratches, grease, oil etc.		-	-	P	-	
3	Core extrusion (Conductor screen, Insulation & insulation screen)	a) Compound Make/Grade	Major	Visual	During m/c setting			-	-	P	-	Insulation screen shall be freely strippable, without application of heat.
		b) Thickness of insulation & extruded S.C. layers	Major	Physical	During m/c setting after stabilisation	Tech. Data Sheet / IS 7098/II/2011	Tech. Data Sheet / IS 7098/II/2011	Reg./Sheet	-	P	V	
		c) Surface finish	Minor	Visual	100 %	Smooth & free from defects		-	-	P	-	
		d) Printing on outer semi- conducting layer	Major	Visual	100 %	"DO NOT HEAT, FREELY STRIPPABLE"		-	-	P	-	
		e) Tensile Strength	Major	Physical	Sample	IS 7098/II/2011	IS 7098/II/2011	Reg./Sheet	-	P	V	
		f) Elongation at break	Major	Physical	Sample	IS 7098/II/2011	IS 7098/II/2011	Reg./Sheet	-	P	V	
		g) Hot set test	Major	Physical	Sample	IS 7098/II/2011	IS 7098/II/2011	Reg./Sheet	-	P	V	
		g1) Ovality of core	Minor	Physical	Sample	Tech. Data Sheet	Tech. Data Sheet	Reg./Sheet	-	P	V	

BSES

ANNEXURE G : QUALITY ASSURANCE PLAN (QAP)

FOR 11 kV H. T. CABLES

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			Remark
									SV	MFR	BSES	
1	2	3	4	5	6	7	8	9	10	11	12	13
	Legend : SV : Sub-Vendor of Cable Manufacturer, MFR : Cable Manufacturer, MPS : Material Purchase Specification,											
	P : Perform, W : Witness, V : Verification											
		h) Eccentricity of insulation	Minor	Physical	Sample	Tech. Data Sheet	Tech. Data Sheet	Reg./Sheet	-	P	V	
		i) Core diameter	Minor	Physical	Sample	Tech. Data Sheet	Tech. Data Sheet	Reg./Sheet	-	P	V	
		j) Void & contamination test for insulation (Silicon Oil test)	Major	Physical	Sample			-	-	P	V	
		k) Wafer boil test for extruded semi-conducting layers	Major	Physical	1 sample/lot	BIS draft Specn	BIS draft Specn	Reg./Sheet	-	P	V	
4	Taping - water Swellable semi-conducting	a) Dimensions	Minor	Physical	Sample	Tech. Data Sheet	Tech. Data Sheet	-	-	P	-	
		b) Tape Application (Overlap)	Minor	Visual	During m/c setting	Suitable overlap	Suitable overlap	-	-	P	-	
5	Taping - Copper tape	a) Width & Thickness of tape	Major	Physical	During m/c setting	Tech. Data Sheet	Tech. Data Sheet	Reg./Sheet	-	P	V	
		b) Number of tapes	Major	Visual	During m/c setting	Tech. Data Sheet	Tech. Data Sheet	Reg./Sheet	-	P	V	
		c) Tape application (Overlap)	Minor	Visual	During m/c setting	Tech. Data Sheet	Tech. Data Sheet	-	-	P	-	
6	Laying up	a) Identification of cores	Major	Visual	During m/c setting	Tech. Data Sheet	Tech. Data Sheet	-	-	P	-	Cores shall be laidup with PP fillers & suitable tape binder shall be provided over laid up assembly
		b) Direction of lay, core Sequence & Lay length	Major	Visual	During m/c setting	IS 7098/II/2011, PIL-W-02	IS 7098/II/2011, PIL-W-02	-	-	P	-	
		c) Application of binder tape	Minor	Visual	During m/c setting	Tech. Data Sheet		-	-	P	-	
		d) Shape of laid up assembly	Minor	Visual	100%	Reasonably circular	Reasonably circular	-	-	P	-	
7	Inner sheath	a) Material & type	Major	Visual	During m/c setting	Tech. Data Sheet	Tech. Data Sheet	-	-	P	-	
		b) Thickness	Major	Physical	During m/c setting & drum change	Tech. Data Sheet & IS 7098/II/2011	ech. Data Sheet & IS 7098/II/2011	Reg./Sheet	-	P	V	
		c) Surface finish	Minor	Visual	100 %	Surface shall be smooth & free from defects		-	-	P	-	
		d) Colour of inner sheath	Major	Visual	100 %	Tech. Data Sheet	Tech. Data Sheet	-	-	P	-	
8	Armouring	a) Dimension of armour wires/strips	Major	Physical	During m/c setting	Tech. Data Sheet	Tech. Data Sheet	Reg./Sheet	-	P	V	No negative tol. on strip thickness/wire diameter
		b) No. of armour strip/wire	Major	Counting	During m/c setting	Tech. Data Sheet	Tech. Data Sheet	Reg./Sheet	-	P	V	
		c) Armour coverage	Minor	Visual	During m/c setting	IS 7098/II/2011	IS 7098/II/2011	-	-	P	-	
		d) Direction of lay	Major	Visual	During m/c setting	IS 7098/II/2011	IS 7098/II/2011	-	-	P	-	
		e) Lay length/Gear setting	Minor	Visual	During m/c setting			-	-	P	-	
		f) Surface finish	Major	Visual	100 %	No cross over/over riding of wire/strip		-	-	P		
9	Outer sheath/Rewinding	a) Material & type	Major	Visual	During m/c setting	Tech. Data Sheet	Tech. Data Sheet	-	-	P	-	
		b) Anti rodent & termite additives	Major	Visual	Each loading			Reg./Sheet	-	P	V	

BSES

ANNEXURE G : QUALITY ASSURANCE PLAN (QAP)

FOR 11 kV H. T. CABLES

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			Remark
									SV	MFR	BSES	
1	2	3	4	5	6	7	8	9	10	11	12	13
	Legend : SV : Sub-Vendor of Cable Manufacturer, MFR : Cable Manufacturer, MPS : Material Purchase Specification,											
	P : Perform, W : Witness, V : Verification											
		b) Thickness	Major	Physical	Each length	Tech. Data Sheet	Tech. Data Sheet	Reg./Sheet	-	P	V	
		c) Overall diameter	Major	Physical	Each length	Tech. Data Sheet	Tech. Data Sheet	Reg./Sheet	-	P	V	
		d) Surface finish & colour of sheath	Major	Visual	100 %	Surface smooth & free from defects. Colour as per Tech. Data Sheet		-	-	P	-	
		e) Cable length verification	Major	Visual	Each length	Manufacturing Plan	Manufacturing Plan	-	-	P	-	
		f) Marking	Major	Visual	Each length	As per approved GTP/cross sectiona drawing		Reg./Sheet	-	P	V	
C	**FINAL INSPECTION**											
1	Routine tests	a) High Voltage	Critical	Electrical	100 %	IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	V	
		b) Conductor Resistance	Critical	Electrical	100 %	IS 8130/84	IS 8130/84	Test Report	-	P	V	
		c) Partial Discharge	Critical	Electrical	100 %	IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	V	
		d) Impulse	Critical	Electrical	One sample per lot			Test Report		P	V	
		e) Armour Coverage	Critical	Physical	One sample per lot			Test Report		P	V	
		f) Physiacal Dimensions	Critical	Physical	One sample per lot			Test Report		P	V	
		g) Freely Strippable insulation screen (Strippability Test)	Major	Physical	One sample per lot	Factory Standard	Factory Standard	Test Report	-	P	V	
2	Stage Inspection	Wire Drawing	Major	Visual	100 %	Tech. Data Sheet	IS/IEC	Test Report	-	P	W	Stage Inspection shall be conducted subject to BSES requirement
		Extrusion process	Major	Visual	100 %	Tech. Data Sheet	IS/IEC	Test Report	-	P	W	
		Raw maerial inspection at factory	Major	Physical	100 %	Tech. Data Sheet	IS/IEC	Test Report	-	P	W	
		Wrapping of Aluminium	Major	Physical	100 %	Tech. Data Sheet	IS/IEC	Test Report	-	P	W	
		Tensile test for Aluminium	Major	Physical	100 %	Tech. Data Sheet	IS/IEC	Test Report	-	P	W	
		a) Annealing test for copper	Major	Physical	Appendix A to IS 7098/II/2011, each lot sample basis	IS 8130/84	IS 8130/84	-	-	P	V	Verification of process records.
		b) Tensile test for aluminium	Major	Physical		IS 8130/84	IS 8130/84	-	-	P	V	
		c) Wrapping test for aluminium	Major	Physical		IS 8130/84	IS 8130/84	-	-	P	V	Tests N/A on finished conductor.
		d) Conductor resistance test	Major	Electrical	Appendix A to IS 7098/II/2011, each lot sample basis	IS 8130/84	IS 8130/84	Test Report	-	P	W	
		e) Test for thickness of insulation & sheath	Major	Physical		IS 7098/II/2011 & Tech. Data sheet	IS 7098/II/2011 & Tech. Data sheet	Test Report	-	P	W	
		f) Hot set test for insulation	Major	Physical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	

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ANNEXURE G : QUALITY ASSURANCE PLAN (QAP)

FOR 11 kV H. T. CABLES

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			Remark
									SV	MFR	BSES	
1	2	3	4	5	6	7	8	9	10	11	12	13
	Legend : SV : Sub-Vendor of Cable Manufacturer, MFR : Cable Manufacturer, MPS : Material Purchase Specification,											
	P : Perform, W : Witness, V : Verification											
3	Acceptance tests	g) Tensile strength & Elongation at break of insulation & outer sheath	Major	Physical	Each Lot Sample Basis	IS 7098/II/2011 & IS 5831/84	IS 7098/II/2011 & IS 5831/84	Test Report	-	P	W	
		h) Partial discharge test	Critical	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		i) High voltage test	Critical	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		j) Insulation resistance (Volume resistivity) test	Major	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		k) Tests for dimension of armour wires/strips	Major	Physical		IS 3975, IS 10810 Pt. 36 & Tech. Data sheet		Test Report	-	P	W	
		l) Test for anti termite & anti rodent property of outer sheath	Major	Physical		Tech. Data Sheet	Tech. Data Sheet	Reg./Sheet	-	P	W	
		m) Rewinding of cable on drum	Major	Visual		To check cable appearance, drum appearance, cable winding, packing, embossing/printing/sequential marking		Reg./Sheet	-	P	W	
		n) Void & contamination test for insulation (Silicon Oil test)	Major	Physical				Reg./Sheet	-	P	W	
		o) Wafer boil test for extruded semi-conducting layers	Major	Physical				Reg./Sheet	-	P	W	
		p) Freely Strippable insulation screen	Major	Physical		Factory Standard	Factory Standard	Test Report	-	P	W	
		q) Water Penetration test (WPT) on core (i.e.Logitudinal Water Blocking Test)	Major	Physical		IEC:60502	IEC:60502	Test Report	-	P	W	**Test shall be conducted for leakage of water through conductor.**
		r) Armour coverage	Major	Physical		As per data sheet & FS	As per data sheet & FS	Test Report	-	P	W	
		s) Ovality	Major	Physical		As per data sheet	As per data sheet	Test Report	-	P	W	
		t) Eccentricity	Major	Physical		As per data sheet	As per data sheet	Test Report	-	P	W	
		u) Mass & uniformity & zinc coating on armour	Major	Physical		As per data sheet & FS	As per data sheet & FS	Test Report	-	P	W	
		v) Resistivity of Strip armour	Major	Electrical		As per data sheet & FS	As per data sheet & FS	Test Report	-	P	W	
		w) Swelling height of water swellable tape	Major	Physical		As per data sheet & FS	As per data sheet & FS	Test Report	-	P	W	
		x) Flammability test	Major	Physical		As per IS-78098/II/2011	As per IS-78098/II/2011	Test Report	-	P	W	
		y)Impulse withstand test	Critical	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	

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ANNEXURE G : QUALITY ASSURANCE PLAN (QAP)

FOR 11 kV H. T. CABLES

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			Remark
									SV	MFR	BSES	
1	2	3	4	5	6	7	8	9	10	11	12	13
	Legend : SV : Sub-Vendor of Cable Manufacturer, MFR : Cable Manufacturer, MPS : Material Purchase Specification,											
	P : Perform, W : Witness, V : Verification											
		z) Ageing & Water absorption test(Gravimetric) on Insulation & Outer sheath	Major	Physical		IS 5831/84	IS 5831/84	Test Report	-	P	W	
		z1) Heating Cycle with Potential	Critical	Electrical	sample basis, once per PO			Test Report	-	P	W	
		z2) Raw Material Verification in all aspects	Major	Physical	Each Lot					P	W	
		Z3) OFC Continuty Test and verification of outer sheath marking with continuous 15mm red strip for OFC embedded identification	Major	Physical	Each Lot					P	W	
4	Type tests at vendor's works	a) Tests on conductor										
		i) Annealing test for copper	Major	Physical		IS 8130/84	IS 8130/84	-	-	P	V	Verification of process records. Tests N/A on finished conductor.
		ii) Tensile test for aluminium	Major	Physical		IS 8130/84	IS 8130/84	-	-	P	V	
		iii) Wrapping test for aluminium	Major	Physical		IS 8130/84	IS 8130/84	-	-	P	V	
		iv) Conductor resistance test	Major	Electrical		IS 8130/84	IS 8130/84	Test Report	-	P	V	
		b) Tests for armouring wires/strips										
		i) Dimensions of wire/strip	Major	Physical		IS 3975, IS 10810 Pt. 36 & Tech. Data sheet		Test Report	-	P	W	
		ii) Tensile strength & Elongation at break	Major	Physical		IS 3975	IS 3975	Test Report	-	P	W	Only for Steel wires/strips
		iii) Torsion test for wire	Major	Physical		IS 3975	IS 3975	Test Report	-	P	W	
		iv) Winding test for strip	Major	Physical		IS 3975	IS 3975	Test Report	-	P	W	
		v) Uniformity of zinc coating	Major	Chemical		IS 3975	IS 3975	Test Report	-	P	W	
		vi) Mass of zinc coating	Major	Chemical		IS 3975	IS 3975	Test Report	-	P	W	
		vii) Resistivity of wire/strip	Major	Electrical		IS 3975	IS 3975	Test Report	-	P	W	
		c) Test for thickness of insulation & sheath	Major	Physical		IS 7098/II/2011 & Tech. Data sheet	IS 7098/II/2011 & Tech. Data sheet	Test Report	-	P	W	
		d) Physical tests for insulation									W	
		i) Tensile strength & Elongation test	Major	Physical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		ii) Ageing in air oven	Major	Physical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		iii) Hot set test	Major	Physical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		iv) Shrinkage test	Major	Physical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		v) Water absorption (gravimetric)	Major	Physical	One sample per Tender	IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		e) Physical tests for outer sheath									W	

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ANNEXURE G : QUALITY ASSURANCE PLAN (QAP)

FOR 11 kV H. T. CABLES

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			Remark
									SV	MFR	BSES	
1	2	3	4	5	6	7	8	9	10	11	12	13
	Legend : SV : Sub-Vendor of Cable Manufacturer, MFR : Cable Manufacturer, MPS : Material Purchase Specification,											
	P : Perform, W : Witness, V : Verification											
		i) Tensile strength & Elongation test at break	Major	Physical		IS 5831/84	IS 5831/84	Test Report	-	P	W	
		ii) Ageing in air oven	Major	Physical		IS 5831/84	IS 5831/84	Test Report	-	P	W	
		iii) Shrinkage test	Major	Physical		IS 5831/84	IS 5831/84	Test Report	-	P	W	
		iv) Hot deformation test	Major	Physical		IS 5831/84	IS 5831/84	Test Report	-	P	W	
		v) Loss of mass in air oven	Major	Physical		IS 5831/84	IS 5831/84	Test Report	-	P	W	
		v) Heat shock test	Major	Physical		IS 5831/84	IS 5831/84	Test Report	-	P	W	
		vi) Thermal stability test	Major	Physical		IS 5831/84	IS 5831/84	Test Report	-	P	W	
		f) Electrical tests in sequence									W	
		i) Partial discharge test	Critical	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		ii) Bending test	Major	Physical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		iii) Partial discharge test	Critical	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		iv) Dielectric power factor as a function of voltage	Major	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		v) Dielectric power factor as a function of temperature	Major	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		vi) Heating cycle test	Major	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		vii) Dielectric power factor as a function of voltage	Major	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		viii) Partial discharge test	Critical	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		ix) Impulse withstand test	Critical	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		x) High voltage test	Critical	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		g) Insulation resistance (Volume resistivity test)	Major	Electrical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
		h) Flammability test	Major	Physical		IS 7098/II/2011	IS 7098/II/2011	Test Report	-	P	W	
D	**PACKING & MARKING**											
1	Packing & Marking	a) Cable end sealing	Major	Visual	100 %	IS 7098/II/2011/ Agreement	IS 7098/II/2011/ Agreement	-	-	P	W/V	BSES representative may verify these characteristics on randomly selected drums.
		b) Pulling eye at leading end- removed from vendor scope, end cap shall be provided at both the end of cable	Major	Visual	100 %	As per agreement	As per agreement	-	-	P	W/V	
		b) Stencilling/Marking on drum	Minor	Visual	100 %	IS 7098(Part 2):2011/ Agreement	IS 7098(Part 2):2011/ Agreement	-	-	P	V	

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FOR 11 kV H. T. CABLES

S. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			Remark
									SV	MFR	BSES	
1	2	3	4	5	6	7	8	9	10	11	12	13
	Legend : SV : Sub-Vendor of Cable Manufacturer, MFR : Cable Manufacturer, MPS : Material Purchase Specification,											
	P : Perform, W : Witness, V : Verification											

Note

1. Checks specified above for Raw Material, In-Process and Final Inspection shall be as relevant to the specific cable construction.
2. Number of samples shall be selected as per Factory Standard/Agreement wherever 'sample' is indicated for extent of check.
3. Plant standards shall be followed in case Technical Data Sheet does not include requirements for characteristics to be checked.
4. BSES may witness Raw material and in process inspection in addition to Routine/Acceptance tests at any time/stage of manufacturing.
5. BSES's Inspector may randomly select a cable drum for type testing at vendor's works.
6. For each of the offered lot for inspection, BSES may randomly select one cable drum for testing of end cap "Destructive testing" to verify adhesion of sealing cap to cable outer sheath. .
7. All factory Type Tests shall be Witnessed by BSES

Annexure- H

Testing and manufacturing process requirements w. r. t. TR- XLPE insulation

All cables made with TR-XLPE Insulation should be tested and/or certified to meet the following performance parameters as per ANSI /ICEA S-94-649 after one year AWTT.

Property	Units	Requirements Values
Min. Avg. Electrical Breakdown Strength(qual. test)	kV/mm	≥ 25
Impulse Strength	kV/mm	≥ 83
Water Tree Length	Mm	0.25
Max. Bowtie Tree Density	(Number per 16.4 cu. cm)	Maximum 15 (0.12-0.25 mm range)

Manufacturing processes to produce high-quality cables with the following characteristics:

- Cure consistency with hot set/creep less than 100%
- No voids larger than 75 microns per 16.4 cubic cm
- No ambers larger than 250 microns per 16.4 cubic cm
- No contaminants larger than 125 microns and less than 5 between 50-125 microns per cubic 16.4 cubic cm tested.
- Neutral indent on cable is less than 375 microns
- Cable insulation concentricity greater than 90% tested
- No protrusions greater than 75 microns at the conductor shield and 125 microns at the insulation shield

Annexure-I: Deviation Format

Sl. No.	Document Name	Clause No.	Deviation	Reason	Merit to BSES