BSES

Specification

for

11kV, 3CX400 sqmm Cable

Specification No: GN101-03-SP-81-01

BSES Rajdhani Power Ltd.							
Prepared by		Reviewed by		Approved by		Rev./Pages	Date
Name	Sign	Name	Sign	Name	Sign		
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Index

Revision Record

Rev. No.	Revision Date	Item/ clause no:	Page No.	Nature of Change	Approved by
1	16.05.2018	2.1.3	06	XLPE to TR-XLPE (Hanwa-CLNA TR-8142, DOW-HFDB-4202 EC, BOREALIS-TR-LE-4121)	CES
2	16.05.2018	7.0.0 (e)	14	Returnable to Non-Returnable Drum	CES

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 10462 (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 XLPE H. T. Cables used in BSES network in Delhi , 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, 3CX400 sq. mm.	Al	A 2X F 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) 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 TR-XLPE (TR-Cross-Linked Poly-Ethylene) Insulation. Technical requirement of TR-XPLE shall be full filled as mentioned in Annexure-H 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	Extrusion	It is desirable 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-3	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, prior to sourcing the compounds and taking up manufacturing of cable.
2.1.4	**Water-Swellable 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.
2.1.5	**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 manufacturer permanently printed at close intervals; this is to provide additional identification of manufacturer of the cable.
2.1.5A	**Copper Tape**	Copper Tape shall be applied helically over the layer formed after application of insulation screen, water-swellable tape and identification strip.
2.1.6	**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.
2.1.7	**Binder Tape**	As per manufacturer's standard
2.1.8	**Inner Sheath**	Extruded Inner Sheath of Black PVC type ST-2 (IS 5831)
2.1.9	**Armour**	a) For 3-core Cables : Galvanized Steel flat strip armour b) Minimum area of coverage of armouring shall be 90 % (min.). At any time, the gap between any two adjacent armour strips shall not be more than the width of strip.

		c) Zero negative tolerance is for : • Thickness of armour strip
2.1.10	**Binder Tape**	Rubberised cotton tape
2.1.11	**Outer Sheath**	a) Extruded outer sheath of PVC (ST-2 as per IS 5831) with termite-repellant and anti-rodent properties. (Outer Sheath shall be FRLS-type, if chosen by purchaser.)
		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 with following minimum text : 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. Progressive (sequential) length of cable at every meter, starting from zero for every drum. Colour filled in for the progressive marking, shall be with proper contrast in colouring. 6. Name of buyer / purchaser, 7. Month & Year of manufacturing 8. IS reference, i.e. IS : 7098 9. 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.) 10. Purchase Order Number & date 11. Word ' FRLSH ', in case the cable is of FRLSH type.
2.1.12	**Pulling-eye Assembly** and **Sealing-end Cap** (for Cables)	a) A cable pulling-eye assembly Drg. No. MISC/E/4-1131/1698 (see Annexure-E) 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. b) Other end (inner end) of the cable shall be sealed as per MISC/E/4-1131/1699 (see Annexure-E.) 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.
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	1. Cables must be of type tested from CPRI/ERDA.. Type Test Reports shall be submitted for the type, size and rating of cable offered in the bid. 2. In case, cable is not type tested, same shall be carried out from CPRI/ERDA against BRPL lot on sample basis.
	b) BSES QAP	In general, all tests mentioned in the BSES QAP

	(Typical)	(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. PD 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). 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 sufficiently in advance to the purchaser. 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. b) "Void-and-contamination Test" for the Insulation

		c) "Strippability Test" at both the ends of cable for each drum, to check freely-strippable property of the Insulation Screen (outer semi-con). d) "Water Penetration Test (WPT)", as per applicable IEC standards, to check adequacy of water-blocking arrangement provided inside the conductor. Number of times WPT is to be carried out, during Acceptance Test, once in each PO. This will have to be repeated if construction of water blocked conductor is changed. e) Heating cycle test along with potential shall be applicable on sample basis once in a PO. Jointing and Termination kits required for this test shall be in the scope of bidder. Test may be done at NABL approved lab or in bidder factory. All the cost regarding this test shall be in bidder scope. f) Internal type test shall be carried out once against each every BRPL PO, on sample basis at manufacturer lab.
	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) Dimensional drawing for pulling eye e) Fault Level Calculation for armour and copper tape screen f) Complete Cable Catalogue and Manual g) Armour Coverage Calculation
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	11 kV, Three core	300 mtr +/- 5 %
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.

		11 kV cables, minimum acceptable short length cables can be 250 meter and only one short length drum shall be acceptable in last lot. In any case, manufacturer shall not put two cable pieces of different short lengths in same cable drum.
7.0.0	**Packing, Shipping, Handling & Storage**	
	a) Packing	1. Both the ends of the cables shall be properly sealed to prevent any deterioration of the cable, due to ingress of water, etc. 2. Cable inner end (starting end) shall project, outside the completely wound cable, by sufficient length enabling verify cable details, including the initial length marking. 3. 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. 4. 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. Alternatively PP sheets can be put as protective covers. 5. 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	Direct marking (i.e. text painting through stencils,

	Markings:	etc.) shall be done on the drums, instead of attaching labels, which may be misplaced/lost over a period of time. 1. Drum identification number 2. Cable voltage grade 3. Cable code (e.g. A2XFY, etc.) 4. Number of cores and cross sectional area 5. Cable quantity, i.e. cable length (meter) 6. Purchase order number & date 7. SAP item code 8. Total weight of cable and drum (kg) 9. Manufacturer's Name 10. Buyer's name 11. Month & Year of Manufacturing 12. Direction of rotation of drum 13. 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	Non-Returnable Steel drums, 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 BSES QAP format for purchaser's approval before manufacturing.

8.0.2	Inspection Points	To be mutually identified and agreed upon in QAP.
9.0.0	**Progress Reporting**	
9.0.1	Outline Document	To be submitted for purchaser's approval for outline of program 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 program 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 are only acceptable, where the Seller has listed in his quotation the requirements he cannot, or does not, wish to comply with, and the Buyer has accepted, in writing, the deviations before the order is placed. b) In the absence of any list of deviation, it will be assumed by the Buyer that the Seller complies fully with this specification. 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 be considered as a deviation from this tech spec at any stage of contract.

Annexure – A

Scope, Documentation and Delivery schedule

1. Scope

A.	Scope	Design, manufacture, testing at manufacturer's works before dispatch, packing, delivery, unloading, stacking at stores/site of H.T. Power cables, as per Purchaser's BOQ (Bill of Quantity).
B.	Delivery Schedule	To be filled up on a case-to-case basis.

a) **Document Submission**

Submission of drawings, calculations, catalogues, manuals, test reports shall be as follows. (Also refer clause 5.0.0 – Drawings, Data and Manuals.)

Legend:

GTP : Guaranteed Technical Particulars
TTR : Type Test Report
RTR : Routine Test Report

	Documents Along with offer	After award of contract - for Approval	Final documents (after Approval)
GTP	3 copies	** 1 soft copy	** 1 soft copy + CD
Drawings	3 copies	** 1 soft copy	** 1 soft copy + CD
Calculations	3 copies	** 1 soft copy	** 1 soft copy + CD
Catalogues & Manual	1 copy each		** 1 soft copy + CD
Test Report	1 copy each of TTR and sample RTR		** 1 soft copy + CD

** Soft copy and CD shall contain documents duly approved, signed and scanned.

3. Delivery Schedule

a)	Delivery period Start Date	:	from date of LOI / LOA
b)	Delivery period End Date	:	as agreed with supplier
c)	Material dispatch Clearance	:	after inspection by purchaser

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)			
	11 kV, 3c x 400 sq. mm.	A2XFY		
6.0	**Voltage Grade**			
	11 kV, 3c	6.35 / 11	kV	
7.0	Maximum Conductor temperature			
A	Continuous	90	deg. C	
B	Short time	250	deg. C	
8.0	**Conductor**			
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 e		
E	Dia. of wires in each conductor before compaction	Manufacturer Standard	mm	

F	Diameter over conductor		mm	
G	Maximum Conductor resistance at 20 ° C			
	11 kV, 3c x 400 sq. mm.	0.0778	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	37.6	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			
	11 kV, 3c	3.6	mm	
C	Minimum thickness (at a point)			
	11 kV, 3c	3.14	mm	
D	Diameter over Insulation (Approx.)		mm	
E	Make and grade of Insulation compound			
F	Eccentricity	As per IEC standards	%	
G	Water-tree retardant property	NA		
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	As per IEC Standards	%	
b.	Diameter over Insulation Screen (apprx.)		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%	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 (apprx.)		mm	
12.0	**Filler** (Material and type)	As per Cl. 2.1.7 (Specify no. & size of filler at center & core interstices)		
	11 kV, 3c x 400 sq. mm.			
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			
	11 kV, 3c x 400 sq. mm.	0.7	mm	

C	Approx. dia. over inner sheath		mm	
14.0	**Armour**	as per purchaser's site-specific requirements		
A	Material			
	11 kV, 3c	G. I. Strip	No.	
C	Armour – GI strips a) Width of strip & Thickness of strip b) Number of strips (min.)	4 x 0.8 (zero negative tolerance for thickness)	mm no.	
D	Approx. Equivalent Area		sq. mm.	
E	Area covered by armour	Min. 90 % Calculation shall be attached.	%	
F	Dia. over armour - apprx.		Mm	
G	Fault current carrying capacity of armour	Calculation sheet shall be attached.	... kA for ... sec.	
15.0	**Outer Sheath**			
A	Material and type	PVC Compound , ST-2, as per IS 5831:1984		
B	Thickness (min.)	3		
	11 kV, 3c x 400 sq. mm.	**	mm	
C	Color	Blue		
D	Embossing (details as per Cl. 2.1.12)	Yes / No		
E	FRLS Properties	As per customer's requirement		
16.0	Approx. overall diameter		mm	
17.0	Standard drum length with tolerance			
	11 kV, 3c x 400 sq. mm.	300 +/- 5%	meters	
17A	Overall order tolerance	+ / - 2 % for the total cable length for the entire order.		
18.0	**Cable Drum**			
a.	Type of drum	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. Pulling-eye Assembly** (provided at one running end) Refer drawing in Annexure-E	Is manufacturer's / Sub-vendor's drawing submitted? (Yes / No)		
	b. Sealing-end Cap (provided at the other end) Refer drawing in Annexure-E	Is manufacturer's / Sub-Vendor's drawing submitted? (Yes / No)		
20.0	**Weights**			
	a) Net weight of cable (apprx.)		kg / km	
	b) Weight of empty drum		Kg	
	c) Weight of Cable with drum		kg	
21.0	Continuous current rating for standard I. S. condition laid Direct			
	a) In ground 30° C	400	Amp	
	b) In duct 30° C	IS/IEC	Amp	
	c) In air 40° C	520	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	
24.0	Recommended minimum	--- x O. D.	mm	

	bending radius			
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	Dry Cure process 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

Ser. No.	Raw Materials		Name of the Suppliers
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 / powder	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)
		1	Aggarwal Metal
		2	Indian Smelting

6.	Copper Tape	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
		2	Shakun
		3	Kalpana

Annexure - D

Service Conditions

(Atmospheric / Soil conditions at Site)

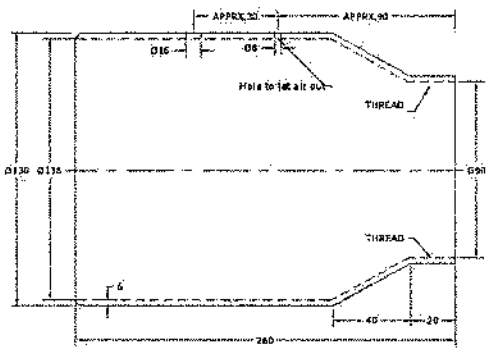
B.	**Delhi**	
a)	Average grade atmospheric condition	Heavily polluted, dry
b)	Average grade soil condition	
c)	Maximum altitude above sea level	1000 M
d)	Air temperature Ambient	i) Highest : 50 deg C ii) Average : 40 deg C iii) Minimum : 0 deg C
e)	Relative Humidity	100 % max
f)	Thermal Resistivity of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

Annexure E

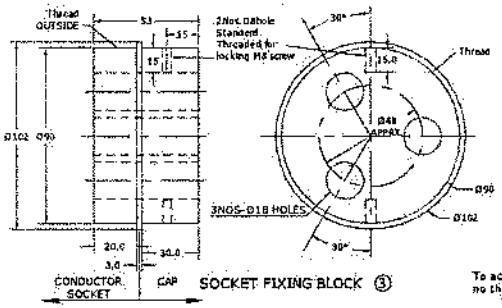
1. **General Arrangement Drawing for Cable Pulling Eye**

2. **General Arrangement Drawing for End-sealing Cap**

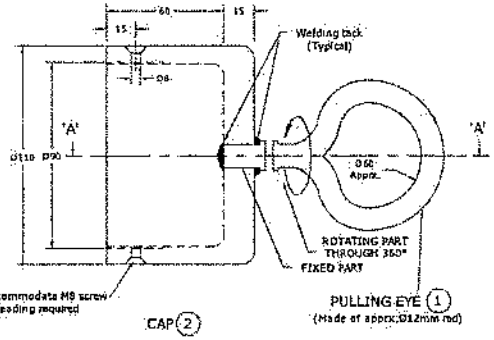
Both the above drawings are given on next pages.



PULLING BLOCK HOUSING ④

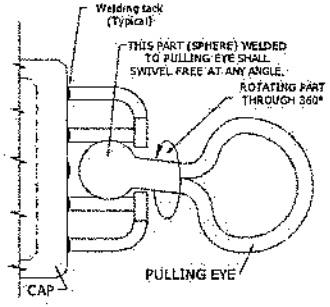


SOCKET FIXING BLOCK ③

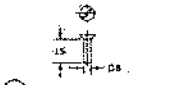


CAP (2)

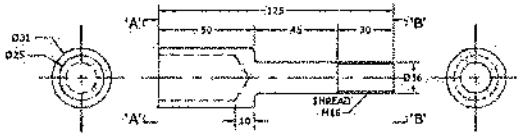
PULLING EYE (1)
(Made of approx.Ø12mm rod)



OPTIONAL ARRANGEMENT



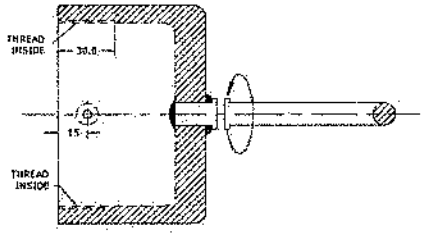
⑩ LOCKING SCREW
(Suitably long to fix CAP (2) with socket fixing block (3)



VIEW-A

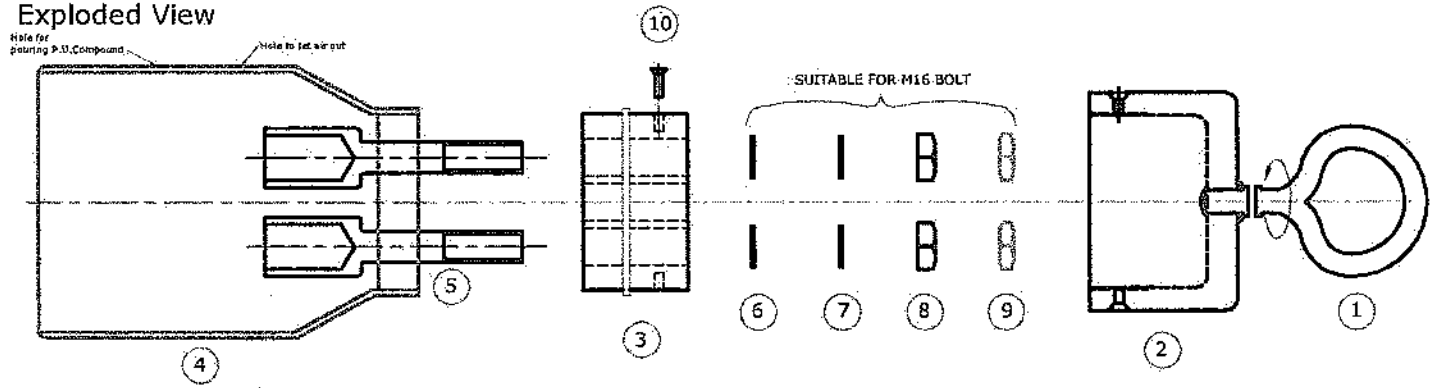
VIEW-B

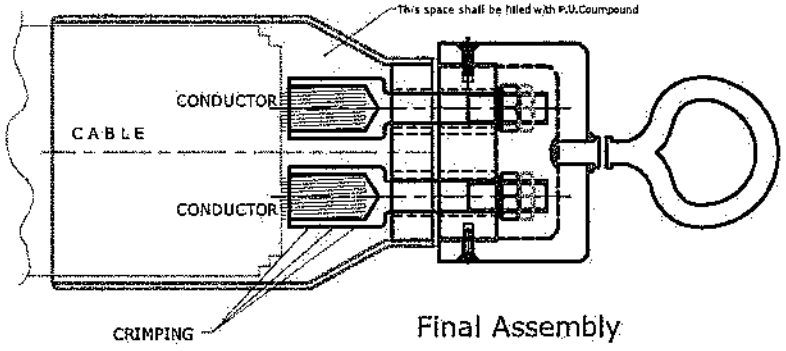
CONDUCTOR SOCKET ⑤
(for crimping on conductor)



SECTIONAL VIEW

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

RELIANCE

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

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

CABLE PULLING EYE ASSEMBLY (TYPICAL)

DRAWN BY: BJR | CHECKED BY: AP/DS/PS | APPROVED BY:

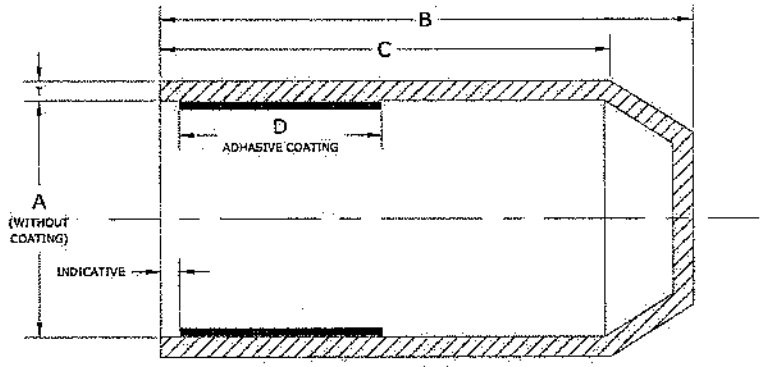
REVISIONS

Adst V.P.

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

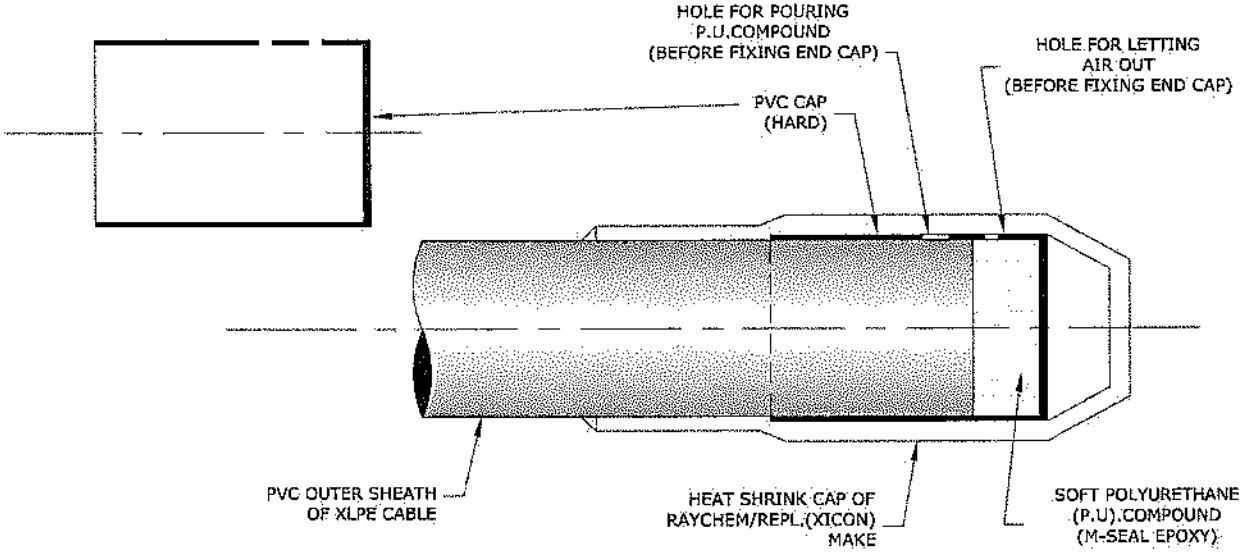
EXP - Expanded (as supplied), REC - Recovered freely, LC - Longitudinal Change,T - Wall Thickness, EC - End Cap



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 D149 / IEC 243
3	Dielectric Constant	Type	5 (max)	ASTM D150 / 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.

RELIANCE

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

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

END SEALING CAP
(FOR XLPE CABLE)

DRAWN BY: BJR | CHECKED BY: AP/DS/PS | APPROVED BY:

REVISIONS

Addl. V.P.

Annexure- F

QAP Format
(Quality Assurance Plan)
For H. T. Cables (Typical)

Vendor shall submit the QAP, duly filled in accordance with IS / IEC standards and manufacturer's standards/procedures, for Purchaser's approval, during pre-order / post-order stages before manufacturing.

Annexure- G

Inspection Expenses:

- Inspection (i.e. routing test, acceptance test, type test, factory visit etc.) shall be done any time by BSES on the basis of PO or may involve 3rd party as per BSES requirement. Inspection expenses like accommodation, fooding, local transport, air fare, train fare, taxi (NCR) etc shall be borne by seller.

- Any kind of test (routine/type test/acceptance test if any) at 3rd lab (i.e. CPRI/ERDA/NABL approved lab) shall be carried out by seller at their own cost. BSES may witness the test and the expenses like accommodation, fooding, local transport, air fare, train, taxi etc. shall be borne by seller.

- Above expenses shall be applied at each and every inspection and shall stand till closing of PO/WO/Rate contracts etc.

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