LT CABLE AND CABLE ACCESSORIES

1. GENERALCONSTRUCTION

1.1. The cables shall be suitable for laying in trenches, ducts, and conduits and for underground buried installation with uncontrolled backfill and possibility of flooding by water andchemicals.

1.2. Outer sheath of all PVC and XLPE cables shall be Black in Colour so as to have UV protection and designed to afford high degree if mechanical protection & shall also be heat, oil, chemical & weather resistant. The cable sheath also suitable to protect against rodent and termiteattack.

1.3. Sequential marking of length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing/engraving shall be legible andindelible.

1.4. The overall diameter of the cables shall be strictly as the values declared in the technical information furnished along with bids subject to a maximum tolerance of +2&-2mm up to overall diameter of 60mm & +/-3mm for overall diameter beyond 60 mm.

1.5. PVC / Rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand meter length. In addition, ends if the cables shall be properly sealed with caps to avoid ingress of water during transportation andstorage.

1.6. PVCCables

1.6.1. All power / control cables for use on medium voltage systems shall be heavy duty type , 1,100V grade with aluminum / copper conductor, PVC insulted, inner-sheathed, armored and overall PVC sheathed as detailedbelow:

1.6.2. The conductors shall be "stranded" for both aluminum and copper cables. Conductors of nominal area less than 25 sq. mm shall be circular only. Conductors of nominal area 25 sq.mm and above may be circular of shaped. Cables with reduced neutral conductor shall have sizes as per Table 1 of IS 1554(Part-1). If specified in the data sheet, the copper Cables shall betinned.

1.6.3. The core insulation shall be with PVC compound applied over the conductor by extrusion and shall conform to the requirement of type "A" compound as per IS : 5831. The thickness of insulation and the tolerance on thickness of insulation shall be as per Table 2 of IS : 1554 part-1. Control cables having 6 cores and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers shall contrast with the color of insulation with a spacing of maximum 50 mm between two consecutivenumbers.

Colour coding for cable up to 4 cores shall be as per applicable Indianstandard.

1.6.4. The inner sheath shall be applied over the laid-up cores by extrusion and shall be PVC compound conforming to the requirements of type ST1 PVC compound as per IS: 5831. The minimum thickness of inner sheath shall be as per Table 4 of IS:1554-Part-1.

1.6.5. The outer sheath for the cables shall be applied by extrusion and shall be of PVC compound conforming to the requirements of type ST-1 Compound as per IS: 5831. The thickness of outer sheath shall be as per relevant table of applicable latest IS:1554(part-1).

1.7. XLPECABLES:

1.7.1. Power cables for 1.1KV shall be aluminum conductor; XLPE insulated screened, sheathed, armoured and overall PVC sheathed as detailedbelow:

1.7.2. The conductors shall be stranded and compacted circular for 1.1 KV cables & should meet therequirement.

1.7.3. 1.1KV cables shall be provided with both conductor screening and insulating screening. The conductor shall be provided with non-metallic extruded semi conducting shielding. The conductor screen shall be extruded in the same operation asinsulation.

1.7.4. The core insulation shall be with cross linked polyethylene insulating compound applied by extrusion & should be manufactured with Dry/Gas curing process. It shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating condition. It shall conform to the properties given in Table-1 of IS:7098(Part-2).

1.7.5. The insulation shielding shall be provided over the insulation & shall consist of non-metallic extruded semi-conducting compound in combination with a non-magnetic metallic screening of copper tape/wires. The copper screen of all cores combined shall be capable of carrying the Single line to ground fault current for the duration specified in the data Sheet, otherwise 300 Amps for screen of each core for duration of one Second. Vendor shall furnish calculation in support of selection of the size of copper screen along withbids.

1.7.6. The conductor screen, XLPE insulation and insulation screen shall be extruded in one operation by "Triple Extrusion Dry. Cured" process to ensure perfect bonding between the layers. The core identifications shall be colored strips or by printednumerals.

1.7.7. The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of typeST2

compound of IS: 5831. The extruded inner sheath shall be of having uniform thickness.

1.7.8. For multi core cables, the armouring shall be by galvanized steel strips. The dimensions of strips shall be as per latest edition of IS: 3975. If armouring is specified/required for single core cables in that case, the same shall be with H4 grade hard drawn aluminum roundwire.

1.7.9. The outer sheath of the cables shall be of PVC compound conforming to the armouring and shall be of PVC compound conforming to the requirements of Type ST2 compound of IS:5831 with suitable additives shall be provided (To prevent attack by rodent & termite). The thickness of outer sheath shall be as per amendment No. 1 to Table 5 of IS: 798-part-2.

1.7.10. The dimensions of the insulation, inner sheath and armour materials shall be governed by values given in latest IS: 7098(pt.2)1958.

1.8. CABLEACCESSORIES:

1.8.1. The straight through jointing kits for use on the systems shall be suitable for the type of cables offered as per thisspecification.

1.8.2. The accessories shall be supplied in kit form. Each component of the kit shall carry the manufacturer's mark oforigin.

1.8.3. The kit shall include all stress grading insulating and sealing materials apart from conductor fittings and consumable items. An installation instruction sheet shall also be included in eachkit.

1.8.4. The contents of the accessories kit including all consumables shall be suitable for storage without deterioration at a temperature of 45 degC, with shelf life extending to more than 5years.

1.8.5. Makes of kit other than those specified in data sheet may be considered for acceptance if type certificates along with CPRI approved drawings accompany the offer. The details of type tests shall be as per cl. 4.2 of thisspecification.

1.8.6. Terminating kits: The straight through jointing kits shall be suitable for installation on ducts and for underground burial with uncontrolled backfill and possibility of flooding by water and chemical. These shall have protection against any mechanical damage and suitably designed to be protected against rodent and termite attack. The jointing Kits shall be one of the makes/ types mentioned in the datasheet.

2. TESTING ANDINSPECTION:

The cables shall be tested and examined at the manufacturer's works. All the materials employed in the manufacture of the

cable shall be subjected, both before and after manufacture, to examination, testing and approval by .

Manufacture shall furnish all necessary information concerning the supply to DGVCL .Manufacture shall furnish all necessary information concerning the supply to DGVCL inspectors. The inspectors shall have free access to the manufacturer's work for the purpose of inspecting the process of manufacture in all its stage and he will have the power to reject any material which appears to him to be of unsuitable description or of unsatisfactory quality.

2.1. PVC & XLPECABLES:

2.1.1. After completion of manufacture of cables and prior to dispatch, the cables shall be subjected to type, routine, acceptance and special tests as applicable. DGVCL reserves the right to witness all tests with sufficient advance notice from vendor. The test reports for all cables shall be got approved from the engineer before dispatch of thecables.

2.1.2 All routine tests, acceptance tests, type tests and additional type tests for improved fire performance shall be carried out on cables as listed in IS: 1554 Part-1, and IS: 7098 Par-2.

2.1.3. The material of fillers & inner sheath shall be compatible with the temperature ratings of the cable & shall have no detorious effect on any other component ratings of the cable. The outer sheath of XLPE cables shall be subjected to all the tests applicable for PVC cables. The test requirement for insulation and sheath of PVC cables shall be as per latest revision of IS:5831.

2.1.4. Following are the special tests to be performed on the cables if applicable and tests result for similar type of cables shall accompany theoffer.

a) Accelerated water absorption test for insulation as per NEMA-WC-5. (For PVC Insulated cables) and as per NEMA WC-7 (for XLPE insulatedcables).

b) Dielectric Retention Test: The dielectric strength of the cable insulation testedin

c) If cables with FR PVC outer sheath: Oxygen index Test: The test shall be carried out as per ASTEMD 2863 or applicable Indian standardspecifications.

d) Flammability Test: The test shall be carried out on finished cable as per IS-7098 (Pt.2)1985:IEC-332(1).

Test for rodent and termite repulsion property: The vendors shall furnish the Test details to analyze the property by chemical method.

2.2. CABLEACCESSORIES:

Type tests should have been carried out to prove the general qualities and design of a given type of termination / jointing system. The type tests shall include the following tests shall include the following tests conforming to VDE 0278/IS specification. The type tests certificates shall be submitted along with the offer for such makes of accessories not mentioned in the datasheet.

2.2.1. Rated withstand A.C. Voltagetest
2.2.2. Partial dischargetest
2.2.3. Rated withstand surge voltagetest
2.2.4. Continuous A.C. Voltage test with cycle current load (Number of heatingCycles-3).
2.2.5. Partial dischargetest
2.2.6. Continuous A.C. voltage test with cyclic current load (Number of heatingCycles-63).
2.2.7. Thermal short circuit test
2.2.8. Continuous A.C. Voltage test with cyclic current load (Number of heatingCycles-63).
2.2.9. Rated withstand surge voltagetest
2.2.10. D.C Voltagetest
2.2.1.1. Test under the influence of moisture
2.2.12. Dynamic short circuit test.

3. PACKING ANDMAKING

Cables shall be dispatched in non-returnable wooden drums of suitable barrel diameter. Securely battened, with the take-off end fully protected against mechanical damage. The wood used for construction of the drum shall be properly seasoned, sound and free from defects. Wood preservatives shall be applied to the entire drum. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.

On the flange of the drum, necessary information such as project title, manufacturer's name, type, size, voltage grade of cable, length of cable in meters drum no, cable code, BIS certification mark, gross weight etc. shall be printed. An arrow shall be printed on the drum with suitable instructions to Show the direction of the drum.

ERECTION SPECIFICATION FOR CABLING

Scope :

This is defining the requirements for supply, wherever applicable the installation, testing and commissioning of the cabling system.

Standards:

The work shall be carried out in the best workmen like manner in conformity with this specification, the relevant specification and codes of practice of Indian standards institution, approved drawing and instruction of Engineer-in- charge or his authorized representative issued from time to time. In case of any conflict between the standards, the instructions of Engineer-in-charge shall be binding.

Power cable specification:

Power cables for use on 415 V systems shall be of 1100 Volts grade, aluminum standard conductor, PVC insulated, and PVC sheathed single wire armoured and overall PVC sheathed. Power cables for 1.1kv systems shall be aluminum conductor, XLPE insulated, screened, PVC bedded galvanized steel flat armoured and PVC sheathed cable. All L.T. cables conform to Indian standard specification and relevant sections of IS: 1554 Part-I and II.T. Cables shall conform to IS: 7038 (Part 2). Unarmoured Cables to be supplied shall be from any of the IS/ISI approved makes such as Asian/CCI/Universal/ICI/ICC/Havells.

CABLE LAYING:

4.4.1 Cables as far as possible shall be laid in complete, uncutlengths from one termination to theother.

4.4.2 Cables shall be neatly arranged in the trenches in such a manner so that criss-crossing is avoided and final takes off to the switchgear is facilitated. Arrangement of cables within the trenches shall be responsibility of the contractor. Cable routing between lined cable trench and equipment shall be taken through appropriate supportarrangement.

4.4.3 All temporary ends of cables must be protected against dust and moisture to prevent damage to the insulation. For this purpose, ends of all PVC insulated cables shall be taped with an approved PVC or rubber insulation tape. Use of friction type or other fabric type tape is not permitted. Lead sheathed cables shall be plumbed with lead alloy.

4.4.4. Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cables leaving trenches shall be coiled and provided with a protective pipe or cover, until such times the final termination to the equipments iscompleted.

4.4.5. Directly buried cables, if required shall be laid underground in excavated cable trenches where specified. Trenches shall be of sufficient depth and width for accommodating of all cables correctly spaced and arranged with a view of heat dissipation and economy ofdesign.

Minimum depth of buried cable trench shall be 750mm for low voltage cables, the depth and the width of the trench shall vary depending upon the number of layers of cables as per Indian standard.

4.4.6. As each row of cables is laid in place and before covering every cable shall be given an insulation test in the presence of Engineer-in-charge /DGVCL . Any cable, which proves defective, shall be replaced before the next groups of cables arelaid.

All wall openings / pipe sleeves shall be effectively sealed after Installation of cables to avoid seepage of water inside building / lines trench.

4.4.7 Where cables rise from trenches to D.P. / S.S., MSP etc. they shall be taken in G.I. pipes / HDPE PVC pipe for mechanical protection up to a minimum permissible height.

Cables ends shall be carefully pulled through the conduit, to prevent damaged to the cable. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by themanufacture.

Following guide of the pipe fill shall be used for sizing thepipe Size:

1 cable in pipe - 53% full
2 cable in pipe - 31% full
3 or more cables - 43% full
4 Multiple cables - 40%full

After the cables are installed and all testing is complete, conduit Ends above grade shall be plugged with a suitable weatherproof Plastic compound / "PUTTI" for sealing purpose. Alternatively G.I. Lids or PVC bushes shall be deemed to have been included in the Cost for the same shall be deemed to have been included in the Installation of G.I. pipe and no separate payment shall be allowed.

4.4.8. Where cables pass through foundation walls or other underground structure, the necessary ducts or opening will be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures. The electrical contractor shall determine their location and obtain approval of the Engineer-in-charge before cutting isdone.

4.4.9. At road crossing / railway crossing and other places where cables enter pipe sleeves adequate bed of sand shall be given so that the cables do not slack and damaged by pipeends.

4.4.10. Drum number of each cable from which it is taken shall be recorded against the cable number in cable schedule. Cables shall be so routed that they will not be subjected to heat from adjacent hot piping orvessels.

4.1.1.11. Cables installed above grade shall be run in trays, exposed on walls, ceilings or structures and shall be parallel or at right angles to beams, walls or columns.

4.4.12. In case of individual cables or small groups which run along structure / walls etc. will be clamped by means of 16 SWG GI saddles on 25*6 mm saddle bars. The cost of the saddle and saddle bars shall be deemed to have been included in the installation of cables and no separate payment shall be made on this account. Alternative small group of cables can be taken through 100 mm slotted channel / ISMC 100 / angle support. They shall be rightly supported on structural steel and masonry individual or in groups as required, if drilling of Steel must be resorted to, approval must be secured and steel must be drilled where the minimum weaking of the structure willresult.

Cables shall be supported so as to prevent unsightly sagging.

4.4.13. If required, Cable laid on supporting angle in cable trenches, structures, columns and vertical run of cable trays shall be suitably clamped by means of G.I. Saddle / clamps, whereas cable in horizontal run of cable trays shall be tied by mean of nyloncords.

4.4.14 The identification cable tag, having adequate size from 3 mm thick, 25 mm wide PVC strip, shall be placed on each cable at every 10 Mtrs intervals and at every cable joint locations. The Cable tag shall be tied by nylon string with cable. The tag shall be embossed by letter as stated below asapplicable.

In LT Cable- PSS Name/MSP Name

4.4.15 The PVC Cable terminal ferrules for identification of phase sequence and feeder/PSS/MSP name of LT cables shall be provided at every termination of all cables stating detail as under. In LT Cable- PSS/MSPname/Phase(R/Y/B/N)

4.5Testing:

4.6.1 Before energizing, the insulation resistance of every circuit shall be measured from phase to phase and from phase toground.

4.6.2 Where splices or termination are required in circuit rates above 600volts, measure insulation resistance of each length of cable before splicing and or / terminating. Repeat measurements after splices and / or terminations arecomplete.

4.6.3 Measure the insulation resistance of directly buried cable circuits, before cable trenches are back-filled. Repeat measurement afterback-filling.

For cables up to 1.1 KV grade 1000KV Megger and for H.V.Cables 2.5KV Megger shall beused.

4.6.4 D.C. High Voltage Test shall be conducted after installation on the following and test results are recorded as DGVCL format.

a (All 1000 volts grade cables in which straight through joints have beenmade.

b (All cables above 1.100 V grade.

For record purposes test date shall include the measure values of leakage current verses time.

The D.C. High Voltage test shall be performed as detailed below in the presence of the Engineer-in-charge or his authorized representativeonly.

Cable shall be installed in final position with the entire straight through joints complete. Termination shall be kept unfinished so that (if any) switchgears, transformers etc. are not subjected to test voltage.

The test voltage shall be 18KV DC for 1.1KV grade cables.

Guaranteed Technical Particulars

1.	**General**	:
1.1.	NameofManufacturer	:
1.2.	PlaceofManufacturing	:
1.3.	ApplicablestandardIS/IEC	:
1.4.	Designambienttemperature	:
2.	**Cable parameters**	:
2.1.	Voltagegrade	:
2.2.	Permissible voltage & frequency variation for satisfactory operation	:
2.3.	Nos of cores&size	:
3.	**Continuous currentcarryingcapacity**	:
3.1.	For standard condition asperIS	:
3.1.1.	In air	:
3.1.2.	Inground	:
3.1.3.	Induct	:
3.1.4.	Intrench	:
3.2.	Forsitecondition	:
3.2.1.	In air	:
3.2.2.	Inground	:
3.2.3.	Induct	:
3.2.4.	Intrench	:
4.	**Conductor**	:
4.1.	Material	:
4.2.	ApplicablestandardIS/IEC	:
4.3.	Shapeofconductor	:
4.4.	Nominal cross sectionarea (mm^2)	:
4.5.	Number of wirespercore	:
4.6.	Nominal diameter & cross section area of each wire used in each core of theconductor	:

5. Insulation :

5.1. Material :

5.2. ApplicablestandardIS/IEC :

5.3. Thickness ofinsulation(mm) :

5.3.1. Betweencores :

5.3.2. Between cores &innersheath :

5.4. Tolerance in thickness(percent) of insulation :

5.5. Diameter of core over insulation (mm) :

5.6. Specific insulation resistanceat ninety (90) degree Centigrade (Ohm-Cm) :

6. Filler :

6.1. Material :

6.2. ApplicablestandardIS/IEC :

6.3. Whether suitable for operating temperature of Cable (Yes/ No) :

6.4. No of fillers providedincluding central filler :

7. Innersheath :

7.1. Material :

7.2. ApplicablestandardIS/IEC :

7.3. Extrudedorwrapped :

7.4. Thickness(mm) :

7.5. Diameterofcableoverinnersheath (mm) :

8. Armouring :

8.1. Material :

8.2. ApplicablestandardIS/IEC :

8.3. Typeofarmouring :

8.4. Numberofstrips :

8.5. Diameter of cableoverarmouring :

8.6. Current carrying capacityofarmour :

8.6.1. on continuousbasis(Amp) :

8.6.2. short circuit currentdurationof 1 sec (KA) :

9. Outersheath :

9.1. Material :

9.2. ApplicablestandardIS/IEC :

9.3. Thicknessofsheath :

9.4. Tolerance on thicknessofsheath :

9.5. Overall diameter ofcable(mm) :

9.6. Schemeforidentification :

10. Cableconstants :

10.1. AC resistance per coreatoperating temperature (Ohm / km) :

10.2. DC resistance per core at20°C(Ohm / km) :

10.3. Reactance per core (Ohm/km) :

10.4. Capacitance per core(Microfarad/ km) :

10.5. Insulation resistance at 27°C (Ohm/ km) :

11. Otherparameters :

11.1. Recommended minimum braiding radius (mm) :

11.2. Safepullingforce :

11.3. Cable weight (Kg/km) :

12. Cabledrum :

12.1. Net weight ofcable(Kg) :

12.2. Drum weight(Kg) :

12.3. Shippingweight(Kg) :

12.4. Whether ISI Mark shallbeindicated on drum (Yes/No) :

12.5. Length of cable perdrum(Meter) :

12.6. Whether details shall beembossedas stated in the Technical Specification (Yes/No) :

13. Whether type test reportssubmitted, as stated in the Technical Specification (Yes/ No) :

14. Whether documentation submitted as specified in theTechnical Specification. (Yes/ No) :

15. Whether un-priced schedule of offered items submitted with Technical offer. (Yes/ No) :