

Annex- 3

**TECHNICAL SPECIFICATIONS FOR
EHV 110kV Power Cables**

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1. EHV 110KV CABLES

This specification defines the objectives, guidelines and requirements for Supply, Laying, Testing and Commissioning of Extra High Voltage Cables (110kV) consisting of:

- 7 runs (including 1 spare) of 110KV Underground Cable for route length of approx. 570m at Pariyaram, Near Chalakudy 110KV Substation between the Coordinates - T 111 (GPS 10.31597, 76.38891) to T 113 (10.31816, 76.38516) including all associated materials and accessories.
- Cable end Termination along with support structures for terminating 110 kV Double Circuit Cable at both end of Substations as per bid price schedule (BPS).
- Supply of Single Phase Link Box without SVL with earth bond cable suitable for 110KV XLPE Cable
- 110kV Surge Arrestor Polymer (Silicon Rubber) with all accessories suitable for mounting in Tower
- Heavy Duty Non Magnetic materials Aluminium cast cable bracket / clamp with protective sleeve inside with all fixing materials like fasteners etc. suitable for 110kV 630 sq.mm Cable, Cable Trays etc. as per Bill of Quantities.
- The XLPE cable and its accessories shall be complete with all fittings and components necessary for the satisfactory performance and ease of maintenance.

1.1 EHV cables

Detailed description and its application

This specification defines the objectives, guidelines and requirements for Supply, laying, testing and commissioning of High Voltage Cables for use at any locations as required.

The details of transformer installed capacities with overload capacities shall be furnished in tabular form depending at the time of necessity for communicating the approximate current cable capacity requirement to the contractor. The cable sizes shall also be worked out according to the rated capacity.

Power Supply characteristics shall be as per latest applicable Indian grid standards notified by Central Electricity Authority (CEA), India, as amended from time to time.

The reference characteristics of the network are tabulated as under:

Rated voltage (rms)	110/ kV
Maximum voltage (rms)	123 kV

Frequency	50 Hz
Neutral	Solidly earthed
Short circuit current	31.5kA for 1 sec

Current rating for cables shall be determined taking into consideration the following installation methods as applicable:

- Buried in Ground
- In the tunnels
- On brackets in the trenches
- Inside Ducts / Pipes or Trenchless

Pipes And on the following as per design

data:

- temperature correction
- soil thermal resistivity
- laying depth in ground
- type of laying in cable spacing
- cable grouping factor etc

2. GOVERNING SPECIFICATIONS

The details and specifications applicable to the 110 kV cables are as under:

The cables shall be of 1x630 sqmm 64/110kV grade for 110kV. The cable shall be single core, stranded circular Aluminum conductor, XLPE insulated, corrugated Aluminum or Corrugated Copper sheathed suited for rated fault current and short circuit power, outer covering HDPE sheath and overall graphite coated, conforming to IEC 60840 for 110kV. Multiple runs of cables to be provided as per current carrying capacity.

2.1 Standards

The EHV Cables shall satisfy the requirements given below and shall also comply with standards in force when the cables are manufactured, particularly which are in the following table. (Unless otherwise stipulated in the specifications, the latest version of the following Standards shall be applicable).

S. No.	Specification No.	Title of Specification
1.	IEC 60840 latest	Power cables with extruded insulation and their accessories for rated voltage above 30 kV and up to 150 kV- Test Methods & requirements.
2.	IEC: 62067 latest	Power Cables with extruded insulation and their accessories for rated voltages above 150kV.
3.	IEC : 60228 – latest	Conductors for insulated cables.

4.	IEC: 60502–2-latest Applicable clause only	Cross linked polyethylene insulated Thermoplastic sheathed cables.
5.	IEC 60840 latest	Power cables with extruded insulation and their accessories for rated voltage above 30 kV and up to 150 kV- Test Methods & requirements.
6.	IEC: 62067 latest	Power Cables with extruded insulation and their accessories for rated voltages above 150kV.
7.	IEC 60230 latest.	Impulse test on cables & their accessories.
8.	IEC 60853-2 latest.	Calculation of the cyclic and emergency current rating of cables. Part 2: Cyclic rating of cables greater than 18/30 (36) kV and emergency ratings for cables of all voltages
7.	IEC 60811 latest.	Common test methods for insulating and sheathing material of electrical cables.
8.	IEC 60885 – Part 3 latest.	Electrical test methods for electric cables. Part 3: Test methods for partial discharge measurements on lengths of extruded power cables

2.2 Abbreviations

- IEC – International Electro technical Council
- ASTM- American Society for Testing and Materials
- IS- Indian Standard
- TSS – Traction Sub Station
- ASS – Auxiliary Sub Station
- RSS – Receiving Sub Station
- TR- XLPE – Track Resistant- Cross Linked Poly Ethylene
- FRLS – Fire Retardant Low Smoke
- FRLSZH – Fire Retardant Low Smoke Zero Halogen
- ACTM – AC Traction Manual

3. TECHNICAL REQUIREMENT

The various Constructional features required for the EHV cables are as under:

4.1 Conductor

The Conductor shall be of Aluminium with a cross section of 630 sqmm. The construction shall be reverse concentric stranded Aluminium, compressed conductor. The Manufacturer shall indicate the following details:

- Number of wires
- Diameter of wires

- Quality of Aluminium
- Thickness and construction of sheath.

The conductor shall be formed from Aluminium conductor according to class 2 (compact circular stranded) complied with IEC 60228 latest publication.

The maximum temperatures admissible for the conductor are as follow:

- Continuous service 90°C
- Overload condition 105°C
- Short Circuit condition 250°C

4.2 Conductor screen

A Conductor screen made of semiconducting compound shall be provided over the conductor, by extrusion. The extruded coat shall be continuous, with a constant mean depth, without bump, perfectly adhering to the insulation envelope. A semiconducting tape(s) shall be provided below the extruded semi-conducting conductor screen to prevent penetration of the compound into the underlying conductor. The electric resistivity of the conductor screen shall not be more than 5000 Ω cm at 20°C and not more than 25000 Ω cm at the working rated temperature.

4.3 Insulation

The Insulation envelope shall be of cross-linked polyethylene (TR-XLPE) insulation applied by extrusion. The voltage gradient in the rated working conditions shall be

- Equal to or less than 6 kV/mm at the level of internal semiconductor
- Equal to or less than 3 kV/mm at the level of external semiconductor

The mechanical characteristics shall be as follow:

In delivery condition

- minimal traction resistance : 12.5 Mpa
- minimal elongation before breaking : 200%

After ageing of 168 h at 135 °C

- maximal variation of traction resistance : 25%
- maximal variation of elongation before breaking : 25%

The isolating envelope shall comply with the hot condition

elongation test:

- temperature : (200 \pm 3) °C
- on load duration : 15 minutes
- mechanical constraint : 0.2 Mpa

- maximal elongation on load : 100%
- maximal elongation after cooling : 15%

The insulation compound shall be of high quality, heat, moisture, ozone and corona resistant. Track Resistant XLPE compound should be from reputed manufacturer e.g. Borealis Sweden or NUC Japan or equivalent with satisfactory service experience of more than 5 years. The Insulation shall be applied by triple extrusion and vulcanized using dry curing process to form a compact homogenous body free from micro voids and contaminants. The insulation shall be suitable for operation in wet or dry locations at conductor temperature not exceeding 90 deg. C for normal operation, and 250 deg. C for short circuit conditions

4.4 **Insulation Screen**

The Insulation screening shall be applied direct upon the insulation and shall be of a layer of extruded semi conducting thermosetting compound firmly and totally bonded to the insulation. Semi conducting compound should be from Borealis Sweden or NUC Japan or equivalent with satisfactory services.

Minimum thickness of Insulation screen should be 0.8 mm. The conductor screen, insulation & insulation screen shall be extruded in a single process. (**Triple extrusion**)

4.5 **Water swellable Tape**

The tape shall be semi-conducting water swellable tape to be applied over the extruded insulation screening to block and prevent moisture propagation in a longitudinal direction. The semi-conducting tape shall be suitable for the operating temperature of the cable and compatible with the insulation.

4.6 **Metallic Sheath**

Metallic sheath shall be either of Corrugated Aluminum sheath or Copper sheath. The metallic sheath shall be able to carry a short circuit current of 40/31.5/31.5/31.5kA for 110 kV cables for 1 seconds. The bidder shall be required to submit the calculation of area of aluminum or copper sheath in this support

4.7 **Bedding Tape**

The bedding shall be anti-corrosive layer of Bitumen compound.

4.8 **Outer Sheath**

The outer sheath shall be extruded red/yellow/blue colour or similar as per phase, graphite coated high density polyethylene, type ST-7 confirming of requirement of IEC specifications and extruded continuously. The outer sheath should have embossing at every one meter for Contractor Name, manufacturer name, GED, Voltage grade etc.

The Mechanical Characteristics shall be as follow:

In delivery condition-

- minimal traction resistance : 12.5 Mpa
- minimal elongation before breaking : 300%

After ageing of 240 h at 110°C

- traction resistance:
- minimum value : 12.5MPa
- maximum variation : 25%

Elongation before breaking:

- minimum value : 300%
- maximum variation : 25%

The variation is the difference between the medium value obtained after ageing and the medium value without ageing, expressed in percentage of the last

4. ADDITIONAL REQUIREMENT

KSEBL may decide to visit the works of cable manufacturer to verify the manufacturing process mentioned. The Bidder along with the bid documents shall submit the details regarding cable construction, bill of material and the manufacturing process proposed to be adopted for the manufacturing of cables to be used in the project, along with Quality control measures adopted by the Manufacturer, to ensure:

- The values and tolerances are strictly as per IEC.
- The cable manufacturer exercises strict quality control measures, including stage inspections, routine inspections etc. to ensure conformity to standards.

Periodical inspections of the Manufacturer work, manufacturing processes, Internal Quality control records of the manufacturer etc shall be carried out by the User (GED/Nominated agency), to ensure compliance to Quality standards.

The client will deliver the supply, upon request, only after execution of in-plant inspection operations and satisfactory testing according to the technical requirements imposed.

- The cables shall pass all the tests stipulated in the IEC rules in force on the date of the order.
- The sleeves and the insulating materials used shall meet the guarantee requirements imposed.
- The equipment shall be capable of withstanding intensive use without alteration, and of performing its duty even after extended idle period.
- Assembled Pulling eye shall have to be supplied with all cables.

- Steel drum with steel packing shall have to be supplied

4.1 Cable Accessories and Bonding

I. Straight Through Joints

The straight through Joints should be Pre-moulded Type (for 110kV) of proven technology and make, suitable for underground buried cables. The joint should comprise of stress control sleeves, insulating sleeves and co-extruded dual wall Tubing comprising of an insulating and semi-conducting layer. A mechanical connector with shear head bolts shall make the conductor connection. The product should be type tested as per IEC specifications.

II. General Specifications:

1. The product offered should be proven and should be in use in India for a minimum period of 5 years for the same voltage class. List of past supplies in India to be furnished. Performance certificates to be submitted along with the offer.
2. The product offered should have long (30 years) shelf life. Details of shelf life of each component shall be submitted with vendor proposal.
3. **Offers should be supported with type test certificates (not older than 05 years at the time of vendor approval) from CPRI/CESI/KEMA or accredited test laboratories as per IEC/IEEE specifications, failing which the offers shall be rejected.**

General Specifications for Joints and Terminations for 110kV Cables

- a) The Terminations and Joints should be tested in accordance with both the IEEE 404 as well IEC 60840/62067.
- b) Ease of Installation: The joint body should be a three-piece assembly to allow for easy installation without the use of special tools and also to keep a firm control on the positioning of the stress control cone etc.
- c) The termination body should be a composite housing with moulded silicone shaded profile for the external leakage insulation.
- d) The joint and termination should employ mechanical connectors for which the manufacturer must have a minimum of 10 years of experience in the design, manufacturing and usage.
- e) The terminations should employ a positive sealing at the insulation end to prevent moisture etc from seeping into the cable.

The Terminations and Straight Through Joints for 110 kV cables shall also be of Pre-moulded type suitable for 110kV (E) Grade of higher, single core 630 sq mm or higher, XLPE Insulated, Aluminium sheathed cable.

4.2 Atmospheric and Climatic Conditions

The entire equipment will be designed for operation in hot weather, according to the climatic conditions defined in General Specifications.

The equipment will be sturdy and properly treated against corrosion. This protection shall be suited to the various environmental conditions encountered in the various parts of the network.

It must be noted that environmental conditions will be very severe during construction; these conditions shall not be the cause of any alteration of equipment or material whether already installed or simply stored.

5. MAINTENANCE & LIFE

The cable should be designed for maintenance free best service life best in the industry and not less than 30 years for all types of installation & under prescribed environmental conditions.

6. SPECIAL CONDITION

The manufacturer shall have laid down in-house selection process of the raw material used and shall submit all details, if equivalent raw material is used wherever specified

7. TESTING

- 7.1 Following type tests to be conducted as per IEC 62067, IEC 60840, ASTM &ASTM & another relevant IEC.

S. No.	Name of Type test	Cable	Accessories	Remarks
1	Bending test on the cable followed by installation of the accessories and a partial discharge test at ambient temperature	Yes	N. A	
2	Tan δ measurement	Yes	N. A	
3	Heating cycle voltage test	Yes	Yes	
4	Partial discharge tests – at ambient temperature, and – at high temperature.	Yes	Yes	The tests shall be carried out after the final heating cycle voltage test above or, alternatively, after the lightning impulse voltage test.

S. No.	Name of Type test	Cable	Accessories	Remarks
5	Lightning impulse voltage test followed by a power frequency voltage test	Yes	Yes	
6	Examination	Yes	Yes	
7	Resistivity of semi-conducting screens	yes	-	
8	Short Circuit test on cable	yes	-	
Non-electrical type tests on cable and on completed cable				
9	Check of cable construction	Yes	N. A	
10	Tests for determining the mechanical properties of insulation before and after ageing	Yes	N. A	
11	Tests for determining the mechanical properties of over sheaths before and after ageing	Yes	N. A	
12	Ageing tests on pieces of complete cable to check compatibility of materials	Yes	N. A	
13	loss of mass test on PVC over sheaths of type ST2	Yes	N. A	Applicable when outer sheath is FRLS/ FRLSOH.
14	Pressure test at high temperature on over Sheaths	Yes	N. A	
15	Tests on PVC over sheaths (ST1 and ST2) at low temperature	Yes	N. A	
16	Heat shock test for PVC over sheaths (ST1 and ST2)	Yes	N. A	
17	Hot set test for XLPE insulations	Yes	N. A	
18	Shrinkage test for XLPE insulations;	Yes	N. A	
19	Measurement of carbon black content of black PE over sheaths (ST7).	Yes	N. A	Applicable for Non-FRLS/Non-FRLSOH cables.
20	Shrinkage test for over sheaths ST7	Yes	N. A	
21	Test under fire conditions	Yes	N. A	
22	water penetration test	Yes	N. A	
23	Tests on components of cables with a longitudinally applied metal foil	Yes	N. A	
24	Tests of outer protection of buried joints	Yes	yes	
25	Smoke emission test on outer sheath	Yes	yes	Applicable when outer sheath is
26	Temperature index test on outer sheath	Yes	yes	

S. No.	Name of Type test	Cable	Accessories	Remarks
27	Oxygen Index test on outer sheath	Yes	yes	FRLS/
28	Acid Gas generation test on outer sheath	Yes	yes	FRLSOH

7.2 Change in BOM

The manufacturer shall not change the Bill of Material used in the manufacturing of samples used for routine testing and Type testing as repeated above and that it intends to supply against the contract.

7.3 Type Tests

All the equipment's which are used for this work shall be of proven design and standards to achieve a very high level of reliability in service. An equipment is considered to be proven if it is in successful operation at least for a period of two years.

The contractor shall furnish a summary of type test reports for all the equipment listed below except those equipment which are yet to be type tested being under development within three (3) months period from the date of signing the contract.

- 110 kV (E) grade or above grade, Single Core of size as per given in GTP and XLPE insulated cable with Aluminium sheath.
- Pre-moulded type straight through joint suitable for 110 kV (E) grade or higher, Single core of size as per given in GTP and XLPE insulated, Aluminium sheathed cable.
- Pre-moulded type cable terminations (indoor & outdoor) suitable for 110 kV (E) grade or higher, Single core of size as per given in GTP and XLPE insulated, Aluminium sheathed cable

The cable and cable accessories intended to be used for this work shall be:

- Type-tested within the last Five (5) years period prior to the date of design approval
- Proven in service for at least two (2) years as on the date of design approval

7.4 Submission of Performance Certificates

The bidder/JV partner shall furnish the necessary information in respect of all cables and accessories to prove satisfactory performance of following equipment's during last two years:

- 110 kV (E) grade or above grade, Single Core of size as per given in GTP and XLPE insulated cable with Aluminium sheath.
- Pre-moulded type straight through joint suitable for 110kV (E) grade or higher, Single core of size as per given in GTP and XLPE insulated, Aluminium sheathed cable.
- Pre-moulded type cable terminations (indoor & outdoor) suitable for 110kV (E) grade or higher, Single core of size as per given in GTP and XLPE insulated,

Aluminium sheathed cable

7.5 Type Test Results

Summary of type test results of the above-mentioned equipment will be in the following format:

Name of the equipment	Manufactured by	Rating	Governing Specs. for type test	Name of test	Month/Year conducted	Testing Lab/ Testing House/ manufacturer's works	Result/Remarks

If the type tests of any equipment being supplied for this work are not yet conducted by the contractor then all the type tests as per the relevant IEC shall be conducted at his expense in the presence of employer's representative either at manufacturer's works having requisite facilities and approved by independent laboratory like KEEMA, Netherland or CESI Italy, or at KEEMA, Netherlands or CESI, Milano, Italy, CPRI INDIA etc.

7.6 Details of 'Make of Cables/Accessories

The bidder shall submit to KSEBL the proposed "make" of all the above equipment in the bid form along with other details such as rating, quantity in use, place of installation number of years in satisfactory operation, summary of type test reports of required rating of 110 kV or higher grade of size as per GTP.

Aluminium conductor, XLPE insulated, Aluminium sheath cable along with the bid so as to decide the 'make' of the items. Based on the information thus furnished, KSEBL shall decide the 'make' of the items to be used for the work.

The plant & equipment being supplied against this bid shall conform to relevant IEC standards.

The link box should be of stainless steel and conforming to protection class of IP: 65 to avoid corrosion and entry of water. The thickness of stainless steel should be not less than 3 mm.

7.7 Rejection of Type Test Report

When KSEBL rejects any specific type test report for particular equipment stating the grounds for such rejection, the contractor shall re-conduct the relevant type tests as per the specification in the presence of Employer's representatives before the item is supplied by him. Such type test shall be conducted by the contractor at his own expense at the manufacturer's works approved by independent laboratory like KEEMA, Netherland or CESI Italy, or at KEEMA, Netherlands or CESI, Milano, Italy, CPRI INDIA

in the presence of Employer's representative.

7.8 Type Test Reports

The type test reports of the equipment shall be of the tests carried out either at the manufacturer's works having requisite facilities and approved by independent laboratory like KEEMA, Netherland or CESI Italy, or at KEEMA, Netherlands or CESI, Milano, Italy, CPRI INDIA during the last Five (5) years period as on the date of bid opening. If any type test report is older than 5 years, the type tests will have to be repeated at contractor's cost. Employer may waive some of these tests in case of equipment / sub-assemblies, where the manufacturer can establish to the satisfaction of employer that such tests have already been carried out earlier or where the equipment have been proved in service. In such a case, manufacturer shall submit complete test reports along with necessary certification.

7.9 ROUTINE TESTS

Routine tests shall comprise of visual inspection of the items and all the routine tests as per specification. All these tests shall be conducted in the presence of Employer's nominated representative at the manufacturer's works. Routine test shall be carried out as per specification ICE 60840/IEC 62067 latest versions.

S.no	Name of Routine test	Cable	Accessories	Remarks
1	Partial discharge test.	Yes	N. A	
2	Voltage test	Yes	N. A	
3	Electrical test on over sheath of the cable, if Required	Yes	Yes	

7.9.1 General

The Following tests shall be carried out on each manufactured length of cable:

- a) Partial discharge test;
- b) Voltage test;
- c) Electrical test on over sheath of the cable, if required.

The order in which these tests are carried out is at the discretion of the manufacturer. The main insulation of each prefabricated necessary shall undergo partial discharge and voltage tests according to either 1), 2) or 3) below:

- 1) On accessories installed on cable;
- 2) By using a host accessory into which a component of an accessory is substituted for test;

- 3) By using a simulated accessory rig in which the electrical stress environment of a main insulation component is reproduced.

In cases 2) and 3), the test voltage shall be selected to obtain electrical stresses at least the same as those on the component in a complete accessory when subjected to the test voltages specified.

NOTE: The main insulation of prefabricated accessories consists of the components that come in direct contact with the cable insulation and are necessary to control the electric stress distribution in the accessory. Examples are pre-moulded or pre-cast elastomer or filled epoxy resin insulating components that may be used singly or jointly to provide the necessary insulation or screening of accessories.

7.9.2 Partial discharge test

The partial discharge test shall be carried out in accordance with IEC 60885-3 for cables, except that the sensitivity as defined in IEC 60885-3 shall be 10pC or better. Testing of accessories follows the same principles, but the sensitivity shall be 5pC or better.

The test voltage shall be raised gradually to and held at $1.75 U_0$ for 10 s and then slowly reduced to $1.5 U_0$

There shall be no detectable discharge exceeding the declared sensitivity from the test object at $1.5 U_0$.

7.9.3 Voltage test

The voltage test shall be made at ambient temperature using an alternating test voltage at power frequency. The test voltage shall be raised gradually to $2.5 U_0$ and then be held for 30 min between the conductor and metallic screen/sheath.

No breakdown of the insulation shall occur as per latest IEC 60840 /62067

7.9.4 Electrical test on over sheath of the cable

When the test is required by the particular contract, the cable over sheath shall be subjected to the electrical test specified in Clause 3 of IEC 60229.

7.10 Acceptance tests / Sample tests

7.10.1 General

Acceptance tests for the power cable & its accessories shall be carried out, wherever the same is mentioned in the relevant specification governing the cable and its accessories. All the acceptance tests as mentioned in the governing specification to which the product is manufactured shall be conducted in the presence of Employer's nominated representative by the Contractor at their manufacturing works.

The following tests shall be carried out on samples which, for the tests in terms b), may be drum lengths of cable, taken to represent batches:

- a) Conductor examination;
- b) Measurement of electrical resistance of conductor and of metallic screen;
- c) Measurement of thickness of insulation and over sheath
- d) Measurement of thickness of metallic sheath
- e) Measurement of diameters, if required
- f) Hot set test for XLPE, EPR and HEPR insulation Measurement of capacitance
- g) Water penetration test, if applicable
- h) Tests on components of cables with a longitudinally applied metal foil (if applicable)

S. No.	Name of Routine test	Cable	Accessories	Remarks
1	Conductor examination	Yes	N. A	one length from each batch subject to max of 10 % of lengths
2	Measurement of electrical resistance of conductor and of metallic screen Drum lengths of cable	Yes	N. A	
3	Measurement of thickness of insulation and over sheath	Yes	N. A	
4	Measurement of thickness of metallic sheath	Yes	N. A	
5	Measurement of diameters	Yes	N. A	
6	Hot set test for XLPE insulations	Yes	N. A	
8	Tests on components of cables with a longitudinally applied metal foil.	Yes	N. A	
9	Measurement of capacitance Drum lengths of cable	Yes	N. A	
10	Lightning impulse voltage test for a cable	Yes	N. A	
11	Water penetration test.	Yes	N. A	
12	Partial discharge test	Yes	Yes	One on each type of Accessory, if the number of that type in the contract is above 50.
13	Voltage test	Yes	Yes	

7.10.2 Frequency of tests

The sample tests for item 1 to 9 above shall be carried out on one length from each batch (manufacturing series) of the same type and cross-section of cable, but shall be limited to not more than 10% of the number of lengths in any contract, rounded to the nearest whole number.

The frequency of the other tests as per relevant IEC shall be in accordance with agreed quality control procedures. In the absence of such an agreement, one test shall be made for contracts with a cable length above 20 km.

7.10.3 Repetition of tests

If the sample from any length selected for the tests falls in any of the tests in, further samples shall be taken from two further lengths of the same batch and subjected to the same tests as those in which the original sample failed. If both additional samples pass the tests, the other cables in the batch from which they were taken shall be regarded as having complied with the requirements of this standard. If either fail, this batch of cables shall be regarded as having failed to comply.

7.10.4 Conductor examination

Compliance with the requirements of IEC 60228 for conductor construction, or the declared construction, shall be checked by inspection and measurement when practicable.

7.10.5 Measurement of electrical resistance of conductor and metallic screen

The cable length, or a sample thereof, shall be placed in the test room, which shall be maintained at a reasonably constant temperature for at least 12 h before the test. If there is a doubt that the conductor or metallic screen temperature is not the same as the room temperature, the resistance shall be measured after the cable has been in the test room for 24 h. Alternatively, the resistance can be measured on a sample of conductor or metallic screen, conditioned for at least 1 h in a temperature controlled liquid bath.

7.10.6 Additional Acceptance Tests

The following additional acceptance tests shall be carried out.

- Additional acceptance tests (1 sample/offered lot) shall be carried out for Ovality & Eccentricity. Tensile strength and Elongation on insulation and over sheath before and after ageing and Thermal Stability on outer sheath of power cable.
- Surface finish and length measurement shall be carried on one length of each size of offered lot of power cables.

7.10.7 Short Circuit Test:

Short Circuit test for Power Cables will be conducted by the contractor on the cable at Manufacturer's works having requisite facilities approved by KEMA Netherlands or

CESI Italy or at KEEMA, Netherlands or CESI Milano, Italy, CPRI INDIA & shall be witnessed by KSEBL's authorized representative.

7.10.8 TEST CERTIFICATES

Three copies of the test certificates of successful type tests if any carried out on cables and cable accessories shall be furnished to KSEBL within fifteen days after completion of such type tests.

Three copies of successful acceptance & routine tests carried out on cables and cable accessories and the certificate of inspection issued by KSEBL's representative shall be furnished within 15 days, after the completion of tests by KSEBL's representative.

7.11 RESPONSIBILITY OF CONTRACTOR FOR DELIVERY/SUPPLY

- (a) All defects detected as a result of testing / inspection shall be rectified by the manufacturer at his own expense and shall be documented and corrected prior to shipment. If in the opinion of Employer, a repeat of the test is required after such rectification, this shall also be carried out at the expense of the Contractor.
- (b) No cable / accessory shall be supplied until Employer has inspected the same to his satisfaction and accepted. However, such inspection and/or acceptance certificate shall not relieve the Contractor of his responsibility for furnishing the cables and cable accessories conforming to the requirements of the contract nor prejudice any claim, right or privilege which KSEBL may have because of the use of defective or unsatisfactory items. Should KSEBL waive the right to inspect any item, such waiver shall be obtained by the Contractor from KSEBL in writing and such a waiver shall not relieve the Contractor in any way from his obligation under the contract.