**Annexure – ‘A’**

**SPECIFICATION FOR 33 KV (E) XLPE (CROSS LINKED POLYTHELENE ) DRY GAS CURED INSULATED POWER CABLE**

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| 1.1 | **SCOPE**  This section of the specification covers design, manufacturing, testing, packing, supply and delivery of 33 KV XLPE dry gas cured insulated power cable for effectively earthed system. |
| 1.2 | **STANDARDS**: |
| 1.2.1 | Unless otherwise specified, the cable shall confirm in all respect to IS:7098 (Part-II)-1985  with latest amendment thereof. |
| 1.3 | **CLIMATIC CONDITIONS**: |
| 1.3.1 | The climatic conditions under which are cables shall operate satisfactorily are as follows: |
| (a) | Maximum ambient temperature of air °C : 50 |
| (b) | Minimum ambient temperature of air in shade °C : 4 |
| (c) | Maximum daily average ambient temperature °C : 40 |
| (d) | Maximum yearly average ambient temperature °C : 30 |
| (e) | Maximum relative humidity % :95 |
| (f) | Average no. of thunder storm days per annum 15 |
| (g) | Average annual rainfall cm : 150 |
| (h) | Minimum wind pressure Kg/cm² :150 |
| (i) | Altitude not exceeding above MSL mtrs. : 1000 |
| (j) | Maximum soil temperature at cable depth °C : 30 |
| (k) | Maximum soil thermal resistively cm/watt °C : 150 |
| 1.4 | **PRINCIPLE PARAMETERS** |
| 1.4.1 | 33 kV (E) Grade XLPE, 3-core, power cable shall be of high conductivity, stranded compacted, H.D. aluminium circular shaped conductor with XLPE (cross linked Poly Ethelene) Dry gas cured insulation provided with shielding of extruded semi-conducting material over conductor and XLPE insulation. Each insulated core shall have copper tape screen, laid together and provided with common covering of PVC Inner Sheath (Extruded). Overall galvanized steel strip armour and PVC outer sheath shall be provided. The specification for manufacture of cable shall be conforming to IS :7098 (Part-II) 1985  (latest edition) 33 KV (E) 3 Phase 50 Hzs. |
| 1.4.2 | Outer sheath shall be designed to afford high degree of mechanical protection and shall also be heat, oil, chemical and weather resistant, common acid, alkalis and sealing solution  shall not have adverse effect on material of PVC Sheath. |
| 1.4.3 | Cable shall be suitable or laying in cover trenches and / or buried under-ground in outdoor. |
| 1.4.4 | Cable Parameters |
| (i) | Voltage grade (Uo/U) KV : 33 KV |
| (ii) | Cores Nos. : 03 |
| (iii) | Nominal system voltage KV : 33 |

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| (iv) | Highest System Voltage KV : 36 |
| (v) | System frequency Hz : 50 |
| (vi) | Variation in Frequency % : + 3 |
| (vii)(a) | Maximum allowable temp. of conductor during  continuous normal operation at rated full load current °C : 90 |
| (vii)(b) | Maximum allowable temperature under short circuit  condition °C : 250 |
| (viii) | 1.2/50 microsecond lightning impulse withstand  Voltage wave value KVP : 125 |
| (ix) | 5 Min. Power Frequency withstand voltage (KV rms) 32 |
| (x) | System earthling : effectively earthed. |
| 1.5 | General technical requirements: |
| 1.5.1 | Conductor: |
|  | The cable conductor shall be made from high conductivity stranded high density  aluminum to form compacted circular shaped conductor having resistance within limits specified in IS: 8130/1984 and any latest amendment to it. |
| 1.5.2 | Conductor shield : |
|  | The conductor having semi conducing screen shall ensure perfectly smooth profile and avoid concentration of stress. The conductor screen shall be extruded in the same  operation as the insulation. The semi-conducting polymer shall be cross- linked. |
| 1.53 | Insulation |
|  | The XLPE insulation shall be suitable for 33 kV system voltage and should be manufactured with Dry gas curing process. The bidder shall submit the description of dry gas curing process, with the clear inclusion of equipments/ parameters involved. The manufacturing process shall ensure that the insulation shall be free of voids. The insulation shall withstand mechanical and thermal stress under steady state and transient operating conditions. The extrusion method should give very smooth interface between semi- conducting screen and insulation. The insulation of the cable shall be of high standard  quality generally confirming to IS7098 (part-II)-1985 and any latest amendment to it. |
| 1.5.4 | Insulation shield: |
|  | Non-metallic semi-conducting shield shall be provided over the insulation to confine electrical field to the insulation. The insulation shield shall be extruded in the same operation as the conductor shield and the insulation by suitable extrusion process. The XLPE insulation shield shall be of tended type. The copper metallic overlapped tape shield  shall be provided. |
| 1.5.5 | Filter and inner sheath: |
|  | The sheath shall be suitable to withstand the site conditions and the desired temperature. It shall be of adequate thickness, consistent quality and free from all defects. The PVC sheath shall be extruded. The material of filters and inner-sheath shall be compatible with  the temperature ratings of the cable and shall have no deterious effect on any other |

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|  | component of the cable. Central PVC filter shall also be provided with other peripheral  PVC filers to have proper circular section. |
| 1.5.6 | **Armour**: |
|  | Armouring of galvanized steel strip shall be provided. The dimensions of steel strips shall  be as per latest edition of IS:3975/1979 |
| 1.5.7 | **Outer sheath**  Extruded type ST-2 PVC outer sheath confirming to IS 5381 – (1984) (latest edition) over armouring with suitable additives (to prevent attack by rodents & termites) shall be provided. |
| 1.5.8 | **Construction** |
| 1.5.8.1 | The cable shall have suitable PVC fillers laid up with insulation cores to have subsequently circular cross-section before the inner sheath is applied. The fillers shall be suitable for operating temperature of the cable.  All materials used in manufacturing of cable shall be new, unused and of finest quality. |
| 1.5.8.2 | All materials should comply with the requirements / tests as per applicable IS/IEC specification. Indian Electricity Rules and any other statutory provision of rules &  regulations. |
| 1.5.8.3 | The PVC material used in the manufacturing of cable shall be reputed manufacturer. No recycling of PVC is permitted. The purchaser reserves the right to ask for documentary evidence of the purchase of various materials (to be used for the manufacture of cable) as  per checking of quality control. Quality Assurance plans shall be submitted. |
| 1.5.9 | **Current Rating**  The indicative value of continuous current capacities of Maxi. Conductor temp. of 90°C (for design purpose by field) of the various sizes of the cables are given below: |

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| Sl.No. | Size of 3 core cable  (sq.mm) | Cont. current carrying capacity in Amps. | |
| In ground | In air |
| 1 | 300 | 350 | 455 |
| 2 | 400 | 400 | 520 |

1.5.9.1 Short circuit ratings of various sizes of 3 core cable calculated for duration of one second at maximum temperature of 250°C are given below

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|  | Sl.No. | Size of 3 core cable  (sq.mm) | Conductor short circuit  rating in KA (rms) |
|  | 1 | 300 | 28.32 |
|  | 2 | 400 | 37.76 |
| 1.5.9.2 | The current rating shall be based on maximum conductor temperature of 90°C with ambient site condition specified for continuous operation at the rated current. | | |
| 1.5.10 | **Operation** | |  |
| 1.5.10.1 | Cable shall be suitable for operation under frequency variation of + 3% and voltage | | |

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|  | variation +10% -15 and combined frequency voltage variation of 10% (absolute sum) |
| 1.5.10.2 | Cable shall be suitable for laying in duct or buried background. |
| 1.5.10.3 | Cable shall have heat and moisture resistance properties. These shall be of type & design  with proven record on distribution network service. |
| 1.5.10.4 | **Length**.  The cable shall be supplied in standard drum length of 300 mtrs. + 5% tolerance for all the sizes of cable.  Overall tolerance in total quantity of ordered cables shall be + 2% |
| 1.5.10.5 | **Identification Mark**   1. The cable drum shall be printed with information as per cl. 21:2 of IS and ISI certification mark. Bidder shall submit Xerox copy of valid ISI Licenses with technical bid. 2. For identification of cores, coloured strip of Red, Yellow and Blue colours shall be used for identification of phases. Following details of identification shall be embossed at intervals of length of one meter of cable outer sheath. 3. (a) Name of manufacturer (b) year of manufacture (c) voltage grade (d) Name of   purchaser JSEB” |
| 1.6 | **Tests** |
| 1.6.1 | **A) Type tests**  All the cables offered should have been fully type tested as per relevant standards at any government laboratory. The bidder shall furnish complete sets of type test reports along with the offer.  For any change in design / type already type tested and the design / type offered against this specification, the purchaser reserves the right to demand reputation of type tests without any extra cost. |
| 1.6.1 | 1. Type test certificates for following type test shall be invariably with the offer:    1. Test of conductor       1. Tensile test       2. Wrapping test       3. Resistance test    2. Tests for armouring strips / wires    3. Tests for thickness of insulation and sheath.    4. Physical tests for insulation :       1. Tensile strength and elongation at break       2. Ageing in air oven       3. Hot set       4. Shrinkage test       5. Water absorption |

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|  | 1. Physical tests on outer seath    1. Tensile strength and elongation at break    2. Ageing in air oven.    3. Shrinkage test    4. Hot deformation    5. Bleeding and blooming test 2. Partial discharge test 3. Bending test 4. Dielectric power factor test 5. As a function of voltage 6. As a function of temperature 7. Insulation resistance test (volume resistivity) 8. Heating cycle test 9. Impulse withstand test 10. High voltage test 11. Flammability test |
| 1.6.2 | **Acceptance Test** |
| 1.6.2.1 | The selection of samples for acceptance test shall be 10% of each lot offered for  inspection or part thereof or minimum one drum. |
| 1.6.2.2 | The following acceptance tests shall be carried out on the selected samples as per IS:7098 (Part-II) 1985   1. Annealing test (for copper) 2. Tensile test ( for aluminium) 3. Wrapping test (for aluminium) 4. Conductor resistance test 5. Test for thickness of insulation and sheath 6. Hot set test for insulation 7. Tensile strength and elongation at break test for insulation and sheath 8. Partial discharge test (for screened cables only) 9. High voltage test for 4 hours (as per cl. 19.7.1) 10. Insulation resistance (volume resistivity) test |
| 1.6.2.3 | All the acceptance tests shall be carried out by the firm in the presence of purchaser’s representative at their works. The firm shall give atleast 15 days advance notice to the purchaser to enable him to depute the engineer for witnessing the tests. The test certificates for acceptance test witnessed by inspecting officer / engineer shall be submitted for approval before despatch of  material. |
| 1.6.3 | **TESTS** |

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| 1.6.3.1 | The bidder shall have to submit, well in advance , the following test certificate for following routine tests for approval prior to inspection of the materials for the complete lot offered for inspection at a time.   1. Conductor resistance test 2. Partial discharge test 3. High voltage test for 5 minutes (as per cl. 19.7.2 of IS:7098 / (Part-II)/1985) |
| 1.7 | **Stage Inspection**  The inspection may be carried out by the purchaser at any stage of manufacture. The successful bidder shall grant free access to the purchaser’s representative at reasonable time when the work is in progress. Inspection and acceptance of any cables under this specification by the purchaser, shall not relieve the supplier of his obligation of supplying cable in accordance with the specification and shall not prevent subsequent rejection, if the cable are found defective.  The supplier shall keep the purchaser informed in advance about the programme of manufacturing of cables so that arrangement can be made for inspection.  The purchaser reserves the right to insist for witnessing the acceptance / routine  tests of the bought out items. |
| 1.7.1 | Manufacturing experience & process specification   1. The manufacturer should have at least 6 (six) years of continuous manufacturing and supplying experience in 33 KV or higher grade with Dry cure Dry cooled system. 2. The cable should be manufactured with Dry cure Dry cooled insulated cores using triple extrusion process through common triple cross head.   Documentary evidence for the same to be submitted failing which offer will  be technically disqualified. |
| 1.8 | **Documentation**  The bidder shall furnish following documents along with his offer. |
| 1.8.1.1) | Sectional View showing the General Constructional feature with conductor /  conductor scree / insulation / armouring / inner and outer sheath etc. |
| 1.8.1.2) | Drawing of cable drum with detail of material, dimension of paint etc shall be  submitted. |
| 1.8.1) | All the required type test reports for offered items tested at any Government  recognized laboratory as stated under cl. 1.6.1 (b) |
| 1.8.2) | Literature , pamphlets for the offered items |
| 1.8.3) | List of orders (size wise) executed during last five years for supply of specified sizes of XLPE cables, supplied to State Electricity Boards private firms etc along with quantity, value of the orders, year of supply and delivery schedule. List of  orders executed and under execution shall be submitted separately. The annual |

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|  | turnover in rupees, of the firms to whom the cable have been supplied during  last two years shall be stated. |
| 9 | **PACKING AND FORWARDING** |
| 9.1 | The cable shall be wound on wooden drums as per IS:10418/1972 and packed in drums suitable for vertical / horizontal transport, as the case may be and shall be suitable to withstand rough handling during transport and outer storage. The outer surface of the drum shall be painted with white aluminium pint. Similarly, the inside surface of drum shall have the protective layer of varnish / paint to  protect it from white ants. |
| 9.2 | The wooden drums shall be reinforced with steel bends and strips for better  protection. |
| 9.3 | The end of the cable shall be sealed by means of non-hygroscopic sealing  materials. |
| 9.4 | The following information may be stensilled on the drum with either water proof ink or oil paint.   1. Reference of IS/IEC standard 2. Manufacturer’s name or trademark 3. Type of cable and voltage grade 4. No. of cores 5. Nominal cross-sectional area of conductor 6. Cable code 7. Length of cable on the drum 8. No. of length on the drum (if more than one) 9. Direction of rotation of drum (by means of an arrow) 10. Position of outer end of cable 11. Gross weight 12. Country of manufacture 13. Years of manufacture 14. Reference of A/T & date 15. Property of “JSEB” 16. Name of consignee and the destination   The drum may also be marked with ISI Certification Mark.  Over and above, name plate of aluminium of suitable size and thickness containing all the above information, shall be fixed on the drum in addition to the  painting. |
| 1.9.5 | The firm shall be responsible for any damage to the cables during transit due to  improper and inadequate packing, wherever necessary, proper arrangement for lifting, such as lifting hooks, shall be provided. Any cable found short inside the |

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|  | packing cases shall be supplied by the supplier, without any extra cost. |
| 1.9.6 | Each consignment shall be accompanied by a detailed packing list, containing the following information:   1. Name of consignee 2. Detail of consignment 3. Destination 4. Total weight of consignment 5. Handling and unpacking instruction 6. Bill of materials indicating contents of each package. |
| 1.10 | **Technical and guaranteed particulars**  The bidder shall furnish all guaranteed technical particulars, as called for, in appendix E of this specification particulars, which are subject to guarantee shall be, clearly, identified. Offer not containing these information, will not be  considered for acceptance. |
| 1.11 | **Performance Certificate**  Bidders shall also submit performance reports for the specified size of cables supplied to other State Electricity Boards / reputed firms with the clear indication of the period since when the cables performed satisfactory services. |
| 1.12 | **Legible submission**  Only required relevant legible documents shall be submitted to avoid delay due to back reference. |