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1.0 SCOPE

The specification covers the design, manufacture, testing, supply and delivery in proper packed condition of 120mmsq, 33kV, three core, Copper conductor, cross-linked polyethylene (XLPE) insulated, armoured and screened cables. These cables shall be suitable for the 3 phase AC – 50Hz system and shall primarily be designed for effectively earthed neutral system.

The cables shall conform in all respects to the highest standards of engineering, design, workmanship of this specification and the latest revisions of relevant standards at the time of offer and ZESCO shall have the power to reject any work or material, which in ZESCO's judgment is not in full compliance therewith.

2.0 SYSTEM PARAMETERS

Unless otherwise specified in the schedule of Requirements, the ZESCO distribution system parameters shall be taken to be as follows:

Item	Description	Unit	Nominal Voltage Level		
			33kV	**11kV**	**0.4kV**
1.	Nominal system voltage phase to phase	kV	33	11	0.4
2.	Highest system voltage phase - phase	kV	36	12	0.44
3.	System Frequency	Hz	50 ± 2.5%	50 ± 2.5%	50 ± 2.5%
4.	Method of System Earthing		Resist.	Resist. or Solid	Solid
5.	Impulse withstand voltage (1.2/50 μsec wave)	kV peak	170	95	-
6.	Power frequency withstand voltage 1 minute	kV peak	70	28	3

3.0 ENVIRONMENTAL PARAMETERS

The cables shall be capable of operating under the following environmental conditions:

a) At an altitude of 1,400m above sea level;
b) Ambient air temperature not exceeding a maximum of $+45^0$C or below -1^0C with a daily maximum average of 50^0C;
c) Relative humidity of 85%;
d) Exposure to direct tropical sun; and
e) Frequent and severe lightning storms occurring during summer months (isokeraunic level taken to be 86 days/year).

4.0 DETAILED REQUIREMENTS

4.1 General

All cables, accessories and materials shall be in accordance with the latest editions (including all amendments) of the referenced standards as specified in schedule A of this specification.

All cables shall be suitable for operation: -

a) On an effectively earthed system with earth faults cleared within 30 seconds;
b) Under the loads specified and such sudden variations of load and voltage as may be met with under working conditions on the system; and
c) In the climatic conditions prevailing on site.

4.2 Conductors

All conductors shall be compact circular shaped stranded Copper as specified in the technical schedules. The conductor shall be clean, uniform in size, shape and quality, smooth and free from scale, spills, splits, sharp edges and other harmful defects.

The conductors shall comply with the requirements of the referenced standards.

Where joints are permitted in individual wires formed into a conductor, they shall be made in the manner prescribed in the appropriate standard and the frequency shall conform to the limiting dimensions stated therein. No joints shall be made in the conductor after it has been formed.

4.3 Conductor Screening

Conductor screening shall be employed at rated voltages of 19/33kV for cables insulated with XLPE and shall consist of a layer of extruded semi-conducting material having a smooth even surface in intimate contact with the cable insulation and the conductor but easily strippable from the conductor surface. Full details of stripping the screen shall be provided with the bid.

4.4 Insulation

The insulation shall be of extruded cross-linked polyethylene (XLPE).

4.5 Identification of Cores

The cores of three core power cables shall be identified by numbers or colours as recommended in IEC 60445.

4.6 Cable Marking

The external surface of the cable shall be legibly embossed with the following information on two lines running parallel to the length of the cable, approximately equally spaced around the circumference of the cable:

a) ZESCO Ltd, Copper Electric Cable 19/33kV, Manufacturer's Name, Description of Cable.

   For example, for a 3-core, 120mmsq, XLPE insulated cable, the legend would read as follows:

   ZESCO Ltd, Copper Electric Cable 19/33kV, Manufacturer's Name 3x120mmsq XLPE/SWA/FRPVC

NOTE: The bedding material is not included in the XLPE/SWA/FRPVC naming convention.

In addition, the cable shall be sequentially marked, by indelible printing, indenting or other suitable means, at 1m intervals, to indicate the approximate length of cable remaining on the drum. The numbers shall start with 001, 1m from the inner end of the cable and continue every metre to the outer end.

4.7 Cable Drum Marking

The drum shall be marked in legible and indelible letters on both sides of the drum giving the following information:

a) Manufacturer's name and/or trademark;
b) Rated voltage, conductor material, number of cores and cable size;
c) Serial number or other identification;
d) Reference standard;
e) Year of manufacture;
f) Length and weight of cable on the drum;
g) Gross weight;
h) Dimensions of drum;
i) ZESCO stock code in bold numerals. E.g. **080602 – 0021**;

j) On each flange an arrow with the words "ROLL THIS WAY";
k) "NOT TO BE LAID FLAT" instruction; and
l) Indication by 'T' that wood is treated.

4.8 Protective Coverings

Cables shall have an extruded black Flame-Retardant Polyvinyl Chloride (FRPVC) oversheath with reduced flame propagation properties.

4.9 Discharge Free Construction

Inner conductor shielding, XLPE insulation and outer core shielding shall be extruded in one operation by a special process (e.g. Triple Extrusion Process) to ensure that the insulation is free from contamination and voids and perfect bonding of inner and outer shielding with insulation is achieved. The bidders are requested to elaborate the manufacturing technique adopted by their manufacturers to achieve this motive.

4.10 Laying-up and Fillers

The cores of the multicore cables shall be laid-up together with suitable fillers, wormed circular and binding tapes applied overall.

The direction of lay of the cores shall be right-hand for the multicore power cables. The term "right-hand" has the same meaning as for screw threads.

4.11 Armour

The type of armour shall be round galvanised steel wire armour.

4.12 Current Carrying Capacity & Design Parameters

The maximum continuous current carrying capacity and maximum permissible continuous conductor temperature and the factors for determining such rating and temperature shall be based on referenced standards, subsequent amendments and all conditions prevailing on site.

4.13 Routine Tests

The routine tests required are as follows: -

a) Measurement of the electrical resistance of conductors;
b) Partial discharge test on cables having cores with conductor screens and insulation screens in accordance;

c) Voltage test;
d) Electrical test on oversheath.

The details of facility available in the manufacturer's works in this connection should be given in the bid.

4.14 Sample Tests

The sample tests required by this standard are as follows: -

a) Conductor examination;
b) Check of dimensions;
c) Voltage test for cables of rated voltage above 3.6/6 (7.2) kV;
d) Hot set test for Ethylene Propylene Rubber (EPR), Hard Ethylene Propylene Rubber (HEPR) and Cross-linked Polyethylene (XLPE) insulations and elastomeric sheaths.

4.15 Special Tests

Ageing test as per provisions of IEC 60502 – 2 clause 19.7.

4.16 Previous Type Tests Results

When type tests have been successfully performed on a type of cable covered by IEC 60502 standard with a specific conductor cross-sectional area and rated voltage, type approval shall be accepted as valid for cables of the same type with other conductor cross-sectional areas and/or rated voltages, provided the following three conditions are all satisfied: -

a) The same materials, i.e. insulation and semi-conducting screens, and manufacturing process are used;
b) The conductor cross-sectional area is not larger than that of the tested cable, with the exception that all cross-sectional areas up to and including 630mmsq are approved when the cross-sectional area of the previously tested cable is in the range of 95mmsq to 630mmsq inclusive;
c) The rated voltage is not higher than that of the tested cable.

Approval shall be independent of the conductor material.

The scope of the previous type tests done shall be as per IEC 60502 – 2 clause 18.

5.0 TECHNICAL SCHEDULES (SCHEDULE A & B)

SCHEDULE A: MINIMUM ZESCO REQUIREMENTS

S/N	Detail		Unit	Data
1.	Description			120mmsq 3 core XLPE/SWA/FRPVC 33kV UV stabilized electric Copper cable
2.	Maximum sustained conductor temperature		^{0}C	90
3.	DC Resistance at 20^{0}C		Ω/km	0.153
4.	AC Resistance at 90^{0}C		Ω/km	0.196
5.	Short circuit ratings	Symmetrical (250 ^{0}C)	kA (1 sec)	16.2
		Earth fault (200 ^{0}C)	kA (1 sec)	41.2
6.	Minimum current rating (direct burial/in air)		A	308/313
7.	Ground temperature		^{0}C	25
8.	Ground thermal resistivity		K.m/W	1.2
9.	Depth of laying		m	0.8
10.	Method of installation			Both in air and direct burial under ground
11.	Exposure to sunlight			Yes
12.	Material of conductor			Circular, stranded and compacted Copper
13.	Insulating material			XLPE
14.	Number of cores			3
15.	Colour			Black
16.	Nominal system voltage (U_o/U)		kV	19/33
17.	Maximum permissible operating voltage		kV	36
18.	Conductor size		mm^2	120
19.	Armour			Galvanised steel wire
20.	Armour diameter			As per IEC 60502 – 2
21.	Type of outer sheath			Ultra violet stabilized FRPVC
22.	Cable length per drum		m	300
23.	Type of drum			Treated wooden
24.	Bedding material			Flame-retardant PVC
25.	Detailed requirements as per clause 4.0 above			Required
	Environmental Parameters			
26.	Ambient temperature		^{o}C	-1 to 45
27.	Altitude		m	1400
28.	Relative humidity		%	85
	Drawings/Test Certificates			
29.	Complete manufacturers' cable technical data sheets/brochure in English to be submitted with the bid			Required
30.	Previous type tests certificates/results to be submitted with the bid			Required
31.	Routine test results/certificate to be provided on delivery			Required
32.	Quality assurance certification to be provided with bid			Required
33.	Applicable standard(s)			SANS 1507; SANS 1411; IEC 60502; IEC 60228; IEC 60287; 60445.

SCHEDULE B: TO BE FULLY COMPLETED BY SUPPLIER

S/N	Detail		Unit	Data
1.	Description			
2.	Maximum sustained conductor temperature		^{0}C	
3.	DC Resistance at 20^{0}C		Ω/km	
4.	AC Resistance at 90^{0}C		Ω/km	
5.	Short circuit ratings	Symmetrical (250 ^{0}C)	kA (1 sec)	
		Earth fault (200 ^{0}C)	kA (1 sec)	
6.	Minimum current rating (direct burial/in air)		A	
7.	Ground temperature		^{0}C	
8.	Ground thermal resistivity		K.m/W	
9.	Depth of laying		m	
10.	Method of installation			
11.	Exposure to sunlight		Yes/No	
12.	Material of conductor			
13.	Insulating material			
14.	Number of cores			
15.	Colour			
16.	Nominal system voltage (U_o/U)		kV	
17.	Maximum permissible operating voltage		kV	
18.	Conductor size		mm^2	
19.	Armour			
20.	Armour diameter			
21.	Type of outer sheath			
22.	Cable length per drum		m	
23.	Type of drum			
24.	Bedding material			
25.	Are detailed requirements as per clause 4.0 above?		Yes/No	
	Environmental Parameters			
26.	Ambient temperature		^{o}C	
27.	Altitude		m	
28.	Relative humidity		%	
	Drawings/Test Certificates			
29.	Have complete manufacturers' cable technical data sheets/brochure in English been submitted with the bid?		Yes/No	
30.	Have previous type tests certificates/results been submitted with the bid?		Yes/No	
31.	Will routine test results/certificate be provided on delivery?		Yes/No	
32.	Have quality assurance certifications been provided with bid?		Yes/No	
33.	Applicable standard(s)			