

Title: **SPECIFICATION FOR XLPE-  
INSULATED POWER CABLES  
AND ACCESSORIES FOR  
SYSTEMS WITH NOMINAL  
VOLTAGES OF 44 KV TO 132 KV**

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## **1. Introduction**

This standard has been compiled in order to promote the standardisation, rationalisation and testing of high-voltage XLPE insulated power cables and accessories for the Eskom Distribution and or Transmission Division where required. The failure of any component of an HV cable installation generally results in significant repair cost and disruption to the power system. In order to minimise the risk of this occurring, Eskom has undertaken to only purchase HV cable and accessories that have been type tested as a system in accordance with SANS 60840.

## **2. Supporting clauses**

### **2.1 Scope**

This standard covers Eskom's requirements for single-core XLPE-insulated cables, accessories, and ancillary equipment for systems with AC nominal voltages of 44 kV, 66 kV, 88 kV and 132 kV.

#### **2.1.1 Purpose**

The document is a standard to be implemented for the design of HV cable networks in Eskom. It also lists the technical specifications for XLPE cable and relevant accessories that will be applicable when procuring these items.

#### **2.1.2 Applicability**

This document shall apply throughout Eskom Holdings Limited Distribution Division and where applicable, Transmission Divisions.

## **2.2 Normative/informative references**

Parties using this document shall apply the most recent edition of the documents listed below. The standards and specifications referenced here within, present the minimum requirements that must be met.

### **2.2.1 Normative**

- [1] SANS 1091: National colour standard;
- [2] SANS 61238-1: Compression and mechanical connectors for power cables with copper or aluminium conductors – Part 1: Test methods and requirements;
- [3] SANS 60840: Power cables with extruded insulation and their accessories for rated voltages above 30 kV ( $\mu[m]$  = 36 kV) up to 150 kV ( $\mu[m]$  = 170 kV) - Test methods and requirements;
- [4] NRS 077: XLPE-insulated cables and accessories for systems with nominal voltages of 44 kV, 66 kV, 88 kV and 132 kV;
- [5] NRS 000: NRS definitions;
- [6] SANS 61109 : Insulators for overhead lines - Composite suspension and tension insulators for AC systems with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria;
- [7] SANS 62217: Polymeric HV insulators for indoor and outdoor use - General definitions, test methods and acceptance criteria;
- [8] Cigre TB 555: Artificial pollution test for polymer insulators, WG C4.303, (2013-10) ; and
- [9] Cigre TB 691: Pollution test of naturally and artificially contaminated insulators, WG D1.44, (2017-07).
- [10] 240-56030640: General information and requirements standard for AC high-voltage, AC extra high voltage and DC cable systems;

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- [11] 240-75655504: Corrosion protection standard for new indoor and outdoor Eskom equipment, components, materials, and structures manufactured from steel standard;
  - [12] 240-170000774: Interim insulation pollution test requirements in place of KIPTS;
  - [13] 240-170000629: Revision of HV/EHV cable after installation AC voltage and partial discharge tests;
  - [14] 240-100394368: Approved coating suppliers and products for DSP 34-1658;
  - [15] D-DT-5271: HV cable termination - support structure foundation;
  - [16] D-DT-5271: HV cable termination - support structure details;
  - [17] D-DT-5271: HV cable termination - support cap details;
  - [18] D-DT-5272: HV cable end support (non self-supporting) steelwork assembly details;
  - [19] D-DT-5272: HV cable end support (non self-supporting) steelwork surge arrester mounting plate;
  - [20] D-DT-5272: HV cable end support (non self-supporting) foundation details;
  - [21] D-DT-0890: HV XLPE cable termination with surge arrester conductor assembly;
  - [22] D-DT-0890: HV XLPE cable termination with surge arrester overhead line assembly;
  - [23] D-DT-0890: HV XLPE cable termination (non self supporting) with surge arrester conductor assembly;
  - [24] D-DT-0890: HV XLPE cable termination (non self supporting) with surge arrester overhead line assembly;
  - [25] D-DT-0891: HV XLPE single circuit direct buried joint bay layout;
  - [26] D-DT-0892: HV power cable trench details (flat formation);
  - [27] D-DT-0892: HV power cable trench details (tre-foil formation);
  - [28] D-DT-0893: HV cable bonding and earthing arrangement end-point bonded system;
  - [29] D-DT-0893: HV cable bonding and earthing arrangement double end-point bonded system;
  - [30] D-DT-0893: HV cable bonding and earthing arrangement multiple end-point bonded system;
  - [31] D-DT-0893: HV cable bonding and earthing arrangement cross-bonded system;
  - [32] D-DT-0893: HV cable outdoor termination bonding and earthing arrangement;
  - [33] D-DT-0894: HV cable link disconnecting box manhole details;
  - [34] D-DT-3202: Danger signs;
  - [35] D-DT-8070: HV cable;
  - [36] D-DT-8071: HV cable joints;
  - [37] D-DT-8072: HV cable terminations;
  - [38] D-DT-8073: HV cable termination supports;
  - [39] D-DT-8074: HV cable link disconnecting boxes; and
  - [40] D-DT-8075: Bonding leads for HV cables.

### **2.2.2 Informative**

- [41] 32-9: Definition of Eskom Documents; and
- [42] 32-644: Eskom Documentation Management Standard.

## 2.3 Definitions

### 2.3.1 General

The definitions and abbreviations in NRS 077 and NRS 000 shall apply to this specification.

### 2.3.2 Disclosure classification

**Controlled disclosure:** controlled disclosure to external parties (either enforced by law, or discretionary).

## 2.4 Abbreviations

The abbreviations in NRS 077 and the following shall apply:

Abbreviation	Description
AC	Alternating Current
HV	High Voltage
IEC	International Electrotechnical Commission
N/A	Not applicable
NRS	National Rationalised Standards
NSS	Non-self-supporting
PCD	Pitch Circle Diameter
SANS	South African National Standards
SCOT	Steering Committee of Technologies
SI	Standards Implementation
XLPE	Cross-linked Polyethylene

## 2.5 Roles and Responsibilities

This standard shall be used by manufacturers and Eskom technical evaluations for relevant XLPE insulated power cables and accessories.

## 2.6 Process for monitoring

SCOT.

## 2.7 Related/Supporting Documents

Not applicable.

## 3. Requirements

XLPE HV cable and accessories shall comply with the requirements of NRS 077 and this standard. Where conflicting requirements arise, the requirements of this standard shall take precedence.

### 3.1 Standard installation conditions

- The cable and accessories shall be suited for standard installation conditions given in 240-56030640;
- The cable depth of burial as per Eskom DDT 0892;
- The cable configuration shall be flat or trefoil formation as per DDT 0892;

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- d) In addition, the cable depth of burial and configuration installation conditions shall be in accordance with D-DT-0891 for direct buried joints and for cable with no joints according to D-DT-0892. Furthermore, any project specific technical requirement as specified in the technical schedule for burial depth of cable shall apply;
- e) The cable bonding and earthing arrangement (special bonding) shall be in accordance with D-DT-0893. Furthermore, any project specific technical requirement as specified in the technical schedule for earthing configurations shall apply; and
- f) Standard installation conditions shall be applicable to cable and cable accessories, unless otherwise stipulated.

### **3.2 Cable and cable accessory rated voltage**

The rated voltages for the cable and accessories shall be as per NRS077.

### **3.3 Cable construction and material**

- a) The cable conductor shall be circular, stranded, and compacted aluminium or copper in accordance with NRS 077. The conductor cross-sectional area shall be 500 mm<sup>2</sup>, 1000 mm<sup>2</sup>, 1200mm<sup>2</sup>, 1600 mm<sup>2</sup>, 2000 mm<sup>2</sup>, 2500 mm<sup>2</sup>; The cable and cable conductor nominal diameter shall be stated in Technical schedule B;
- b) The rated continuous current of the cable is to be based on a maximum sustained conductor temperature of 70 °C in order to avoid any potential problems relating to drying out of the soil around the cable, to optimize technical losses and provide an additional reserve margin for emergency (contingency) operation. Furthermore current rating which satisfy the following installation requirements shall be submitted at the time of tender:
  - 1) The 24 hr rating of the cable shall be for a cable conductor temperature not exceeding 90 °C with the following configurations: trefoil, flat formation as per DDT0892 and for flat formation with spacing of 2D;
  - 2) State the rated continuous current for the cables laid in trefoil, flat formation as per DDT0892 and for flat formation with spacing of 2D;
  - 3) In addition state the continuous 90 °C current rating for trefoil, flat formation as per DDT0892 and for flat formation with spacing of 2D;
  - 4) The supporting calculations for each rating, for each configuration and each temperature shall be provided; and
  - 5) All circuit parameters shall be given for the standard installation conditions given in this standard.
- c) The cable conductor shall withstand:
  - 6) A prospective symmetrical short circuit current magnitude and duration as specified in schedule A without exceeding the maximum allowable conductor temperature specified in SANS 60840. Unless otherwise specified, the maximum 3 phase fault level requirement is 40 kA for 1 second;
  - 7) The maximum single phase to earth fault level requirement is 40 kA for 1 second;
  - 8) State in technical schedule B the conductor temperature after a symmetrical fault for 1 second with assuming operation at specified load before fault, in degrees Celsius (°C); and
  - 9) State in technical schedule B sheath temperature after an earth fault for 1 second assuming operation at specified load before fault, in degrees Celsius (°C).
- d) Cable systems in combination with overhead-line systems shall be:

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- 1) Capable of carrying the maximum prospective short circuit fault current of the system for 3 seconds without exceeding the temperature specified in NRS 077, assuming an initial sheath temperature of 70 °C and using an adiabatic calculation. The designer shall indicate the maximum symmetrical and single phase fault current rating required for 3 sec in the technical schedule B;
  - 2) State also in technical schedule B: The conductor temperature after a symmetrical fault for 3 seconds with assuming operation at specified load before fault, in degrees Celsius (°C); and
  - 3) The sheath temperature after an earth fault for 3 seconds assuming operation at specified load before fault, in degrees Celsius (°C).
- e) A longitudinal water block shall be provided in the cable conductor as stated in NRS077;
  - f) The conductor screen shall be as per NRS077. The conductor screen nominal thickness shall be indicated in technical schedule B;
  - g) The cable insulation shall be super clean XLPE as per NRS077;
  - h) The nominal thickness of the insulation shall be stated and also the lowest measured thickness of the insulation shall comply to SANS 60840;
  - i) As per NRS077: the following stresses are to be met:
    - 1) The actual conductor screen radial stress at  $U_0$  kV/mm  $\leq 8,0$ ; and
    - 2) Actual core screen radial stress at  $U_0$  kV/mm  $\leq 4,0$ .
  - j) The core screen shall comply with the requirements of NRS077;
  - k) The cross linking of the core insulation and screens shall be as per NRS077;
  - l) The cable shall have a corrugated seamless aluminium sheath and shall comply with the requirements as specified in NRS077;
  - m) The corrugated seamless aluminium shall have an earth fault current rating of 40 kA for 1 sec;
  - n) The corrugated seamless aluminium sheath shall provide a radial water block for the cable;
  - o) The effectiveness of the applied water barriers shall be confirmed by successful completion of the water penetration test as described in SANS 60840 as per NRS077. Also, as per NRS077 the details of the water barriers shall be provided in the technical schedule;
  - p) The outer sheath shall be applied over the corrugated seamless aluminium sheath and shall comply to the requirements of NRS077;
  - q) The requirement of either a semi-conductive extruded coating or graphite on the outer sheath layer shall be stated in technical schedule A;
  - r) Tunnelled installations shall require a specific engineering report;
  - s) The mass of the cable shall be stated in kg/m in the technical schedule B;
  - t) State in technical schedule B the DC resistance of the conductor at 20 °C, in ohms per kilometre ( $\Omega$ /km);
  - u) State in technical schedule B the AC resistance of the conductor at 70 °C and 90°C , in ohms per kilometre ( $\Omega$ /km);
  - v) State in technical schedule B the AC resistance of the sheath with the conductor at 70 °C and 90°C, in ohms per kilometre ( $\Omega$ /km);
  - w) State in technical schedule B the reactance per phase when cables are laid in closed trefoil and flat formation with 2D spacing and spacing as per Eskom DDT 0892, at 70 °C and 90 °C in ohms per kilometre ( $\Omega$ /km);
  - x) State in technical schedule B the capacitance per phase, in nano-farads per kilometre (nF/km);



- y) State in technical schedule B the zero sequence resistance and reactance are laid in closed trefoil and flat formation with 2D spacing and spacing as per Eskom DDT 0892, at 70 °C and 90 °C in ohms per kilometre ( $\Omega/\text{km}$ );
- z) State in technical schedule B the zero sequence capacitance, ( $\text{nF}/\text{km}$ );
- aa) State in technical schedule B the conductor losses for the maximum conductor operating temperature in  $\text{kW}/\text{km}$ ;
- bb) Provide a dimensioned drawing of the cable cross-section. The dimensioned drawing of the cable cross section shall indicate the location and type of water barriers used to achieve longitudinal water blocking (including the conductor);
- cc) Indicate in technical schedule B the minimum installation bending radius;
- dd) The emergency current rating (calculated in accordance with SANS 60853-2) of the cable shall be provided in technical schedule B;
- ee) Provide in technical schedule B the load profile for cyclic loading and the associated cyclic current rating of the cable. This current rating shall be calculated in accordance with SANS 60853-2;
- ff) Cable life expectancy calculations with all circuit parameters shall be given for the standard installation conditions given in this standard for operating temperatures of 70 °C and 90 °C shall be done and handed as tender receivable; and
- gg) For logistical purposes the length of cable required shall be stated in the technical schedule A.

### **3.4 Cable accessories**

Cable accessories shall be rated as follows:

- a) Cable systems without any overhead-line system combination shall be capable of carrying the maximum prospective short circuit fault current of the system for 1 s without exceeding the temperature specified in NRS 077, assuming a continuous conductor temperature of 70 °C and using an adiabatic calculation;
- b) Cable systems in combination with overhead-line systems shall be capable of carrying the maximum prospective short circuit fault current of the system for 3 s without exceeding the temperature specified in NRS 077, assuming a continuous conductor temperature of 70 °C and using an adiabatic calculation. If no compliant cable systems for 3 second short circuit fault current ratings are available to procure during tender, the system for the overhead-line connections and combinations with cable systems shall not allow for auto reclose protection operations; and
- c) For logistical purposes the quantity of cable joints and terminations required shall be stated in the technical schedule A.

#### **3.4.1 Cable joints**

- a) As per NRS077, straight joints and sheath-interrupting joints shall be suitable for jointing the type of cable offered as per this specification;
- b) The joint offered shall have all the necessary materials to restore the cable as per NRS077;
- c) Mechanical torque-shear connectors shall be offered, and these connectors shall be type tested in accordance with SANS 61238-1;
- d) For sheath-interrupting joints the joint shall be able to use single core or concentric bonding lead/s as follows:
  - 1) 185mm<sup>2</sup> or 300 mm<sup>2</sup> copper bonding leads; or
  - 2) 300mm<sup>2</sup> or 500mm<sup>2</sup> for aluminium bonding leads;
  - 3) As per NRS077, unless otherwise specified in schedule A, it may be assumed that the bonding lead will be terminated at the joint with lugs that have M12 fixing holes;

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- e) As per NRS077, specialised tools that are required during the jointing process shall be stated in schedule B;
- f) As per NRS077, the method used to connect the conductors shall be stated in schedule B and shall be type tested;
- g) Joints shall also be offered with an additional option for a two piece coffin box design,
- h) Where required during tenders, specialised tools shall be specified and made available to purchase by Eskom from the OEM or the supplier; this shall include the tools to perform the cable stripping and preparation, semi-con removal, insulation preparation, the conductor jointing, the stress cone fitting, CSA earthing re-instatement, etc.;
- i) Where a tender requires installation: a written confirmation shall be submitted during tender; the written confirmation shall indicate/ state the following:
  - 1) The installation of the cable system accessories (joints or terminations) shall be performed by an authorised cable jointers (authorised by the cable joint OEM) and shall be supervised by an OEM qualified cable jointer.
- Or
- 2) The installation of the cable system accessories (joints or terminations) shall be performed by an OEM qualified cable jointer who is authorised to joint/ terminate the offered conductor/cable size and voltage rating. This cable jointer may not be employed by the cable joint OEM; and
- j) A drawing of the joint with dimensions and specific information on drawing as per NRS077 shall be submitted with tender documentation.

### **3.4.2 Cable terminations**

The requirements of NRS077 shall apply with the below specific requirements and enforcements of requirements from NRS077:

- a) An outdoor termination shall contain all the materials required to complete the termination for all XLPE with CSA metal sheath cable sizes in this document, or for a cable size specified in schedule A;
- b) The outdoor termination shall be vertical as per NRS077;
- c) Outdoor terminations shall be of the self-supporting or non-self-supporting type (for 44 kV only);
- d) Outdoor terminations for 'inland' and 'coastal' applications shall comply with the requirements for very heavy pollution conditions respectively in accordance with NRS 077; unless otherwise specified in schedule A and as per project specific requirements engineering reports, the unified specific creepage distance as per SANS 60815 for the external insulation of the outdoor terminations shall be 53.7 mm/kV for both inland and coastal applications, this is equivalent to a specific creepage of 31 mm/kV;
- e) Outdoor self-supporting terminations shall be of the silicone rubber composite type. The material offered and the measured creepage distance of the insulator shall be stated in schedule B;
- f) Stabilised or semi-conducting glazed insulators are not acceptable;
- g) Self-supporting outdoor cable terminations shall be suitable for mounting on the medium equipment support cap shown in D-DT 5271, D-D 5271, D-DT-0890 and D-DT-0890;
- h) As per NRS077: Outdoor non-self-supporting terminations for 44 kV shall be of the heat-shrink or cold applied (e.g. the "slip-on") type. If applicable, the material type shall be specified in schedule A;
- i) 66 kV, 88 kV and 132 kV outdoor terminations shall be self-supporting terminations;
- j) In the case of self-supporting type terminations, unless otherwise specified in Schedule A, the diameter of the tinned copper vertical stem shall be 38 mm;

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- k) Non-self-supporting (NSS) outdoor cable terminations shall be suitable for mounting on the cable end support structure shown in D-DT-5272, D-DT-5272, D-DT-0890 and D-DT-0890;
- l) NSS terminations shall be supplied with mechanical torque shear connectors;
- m) Where self-supporting terminations of the wet type are offered, only cold pouring compounds will be accepted;
- n) In the case of self-supporting type terminations, the termination shall be suitable for a mounting Pitch Circle Diameter (PCD) range between 370 mm and 535 mm;
- o) Environmental sealing for outdoor terminations shall include heat shrink tubes fitted up to the base plate or an alternative method subject to Eskom approval;
- p) All outdoor terminations shall be supplied with warning labels to warn operators and members of public of live voltage present on the self-supporting base plate, bonding lead connection and metal bellow. Label to be as per Eskom DDT 3202 SAP no 0172423;
- q) Self-supporting outdoor termination bushings may be of the hollow, silicone oil filled type (wet design type) or epoxy cast type (dry design type). Only composite shed designs shall be allowed for both wet and dry design types. The wet design type without any additional oil reserve tanks shall be preferred. The bonding lead connections for self-supporting outdoor terminations shall always be on the self-supporting base plate, at the bottom;
- r) Non self-supporting outdoor terminations shall be supplied with a leakage current collector, and a heat-or cold shrink environmental final sealing layer. The cold or heat-shrink anti-track tubing or cold or heat applied sheds shall overlap this final sealing layer. The cold or heat-shrink environmental final sealing layer shall also cover and seal the bonding lead connection if applicable;
- s) SF6 Gas-insulated and oil-immersed terminations shall be as specified by NRS077 with additional requirements as per this standard;
- t) Cable terminations into gas-insulated metal-enclosed switchgear (GIS), gas-insulated line (GIL) and transformers (oil-immersed) shall be in accordance with IEC 62271-209 and shall be of the "plug-in" Type A.
- u) For the connector in t), an exact connection fit shall be ensured by obtaining an interface drawing that is jointly performed and approved by the GIS, GIL and / or transformer OEM and the cable termination OEM during the design review phase. Letters shall be submitted during the tender to confirm that such interface drawings will be provided during the design review phase to ensure the correct connection fit and a type tested connection fit method. The interface requirements shall be listed in the technical schedule A& B;
- v) The conductor interface connection between the GIS/GIL equipment with the GIS/GIL cable termination shall be agreed upon between the GIS/GIL cable termination OEM and the OEM for the GIS/GIL equipment to be terminated on during the design review phase of a project, after contract award prior to manufacturing. The connection method shall not compromise any type tested design compliance requirements;
- w) The bonding lead connection for the GIS/GIL cable termination shall be performed with an insulated, metal base plate connection method on the GIS/GIL cable termination. No bonding lead direct connection to the cable CAS or cutting away of the CAS before the cable termination metal bellow shall be allowed;
- x) Environmental sealing for GIS/GIL cable terminations shall include heat or cold shrink tubes fitted up to and onto the insulated metal base plate, or an alternative method subject to Eskom approval;
- y) Where a tender requires installation: a written confirmation shall be submitted during tender; the written confirmation shall indicate/ state the following:
- 1) The installation of the cable system accessories (joints or terminations) shall be performed by an authorised cable jointers (authorised by the cable joint OEM) and shall be supervised by an OEM qualified cable jointer.

Or

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- 2) The installation of the cable system accessories (joints or terminations) shall be performed by an OEM qualified cable jointer who is authorised to joint/ terminate the offered conductor/cable size and voltage rating. This cable jointer may not be employed by the cable joint OEM; and
- z) A drawing of the termination with dimensions and specific information on drawing as per NRS077 clause 7.1.3 shall be submitted with tender documentation;

### **3.4.3 Link disconnecting boxes**

- a) Link disconnecting boxes configurations shall be as per NRS077;
- b) Link disconnecting boxes shall be as per Eskom standard 240-56030640;
- c) Link disconnecting boxes shall be as per Eskom DDT 8074;
- d) Link disconnecting boxes of the manhole type shall be watertight and shall be suitable for mounting within a link-disconnecting box manhole as shown in D-DT-0894;
- e) The IP rating of the link disconnecting boxes of the manhole type shall have a degree of protection of IP68 for a 4 m water head as per NRS077;
- f) Three-way disconnecting boxes shall be of the kiosk type as per Eskom DDT 8074 and be suitable for mounting on a cable termination support structure (structure mounted) in accordance with D-DT-5271. The IP rating from NRS077 shall apply;
- g) Anti-theft link box standard shall be as per DDT 2874;
- h) The link disconnecting box shall make provision for the connection of the incoming bonding leads from the joints without requiring lugs, i.e. bolted clamps shall be provided. Provision shall also be made for the connection of two additional conductors (i.e. two earth continuity conductors) and a bare copper conductor (i.e. the local earth electrode);
- i) Link disconnecting boxes (i.e. kiosks and manhole/structure box casings and lids) shall be manufactured from 3CR12 stainless steel. The colour of the link disconnecting box shall be 'light grey' (G29 in accordance with SANS 1091) unless otherwise approved by Eskom;
- j) All metal parts of the link disconnecting boxes shall be protected against corrosion in accordance with 240-75655504. The detailed corrosion protection specification shall correspond to a "corrosivity category" of C5 (i.e. "very heavy") in accordance with 240-75655504. The detailed specification (DS) number offered in accordance with 240-75655504 shall be stated in schedule B for all parts of the link disconnecting box;
- k) A 150 mm × 150 mm × 0.6 mm electrical danger sign in accordance with D-DT-3202 sheet 3 shall be fitted to the front access door of all kiosk type link disconnecting boxes. The sign shall be secured using sublim/blind/aircraft type rivets;
- l) The link disconnecting box shall be provided with specialised, insulated tools to install, tighten or loosen, remove link and bonding lead connections;
- m) The link disconnecting box shall be provided with a common applied earth connection method, to bond, earth and short out all link and bonding lead connections to a working earth for maintenance work. Proposals shall be submitted during tender stage for such a design;
- n) Proposals for voltage measurement methods of the standing voltages and / or circulating current on the bonding leads inside link disconnecting boxes, without the opening of the link disconnecting box enclosure shall be submitted during tender stage;
- o) The link disconnecting box shall have a 95 kV BIL withstand (10 positive and 10 negative) phase to earth or in accordance with the insulation co-ordination study requirements;

- p) The link disconnecting box shall have a power frequency voltage withstand of 28kV AC withstand for 1 min phase to phase and phase to earth or in accordance with the insulation co-ordination study requirements;
- q) The link disconnecting box shall have a short time current withstand of 40 kA 3 s for all link connections forming part of the fault current return path;
- r) A design proposal for evaluation and approval for the link disconnecting box must be included that demonstrates that internal arc shall be minimized;
- s) A test proposal shall be submitted for evaluation and approval that demonstrates the ability of the link disconnecting box to withstand an internal arc of 40kA for a duration of 1s ;
- t) Installation instruction, torque requirements for the link and bonding lead connections shall be provided;
- u) Only bottom entry of the bonding leads and ECC shall be allowed for kiosk or structure mounted link disconnecting boxes;
- v) The link disconnecting box designs shall ensure a bonded equipotential earth design, and a design whereby the ECC and joint bay earth electrode connection in the link disconnecting box are insulated from the metal enclosure at the entry position and inside the link disconnecting box;
- w) The link disconnecting box for manhole, structure mount and ground mount type shall be fitted with an Eskom evaluated and approved vandal proof locking facility. Provide a design drawing proposal at tender stage for evaluation in technical schedule B; and
- x) A drawing of the link disconnecting box with dimensions and specific information on drawing as per NRS077 shall be submitted with tender documentation.

#### **3.4.4 Sheath voltage limiter surge arrestors**

The SVL rating selection step by step calculations, design and drawings shall be performed for each cable system section earthing and bonding design. The SVL datasheets, type tests and routine tests in accordance with SANS/IEC 60099 shall be submitted as part of any tender offer.

#### **3.4.5 Bonding leads and ECC**

- a) Bonding leads shall be as per Eskom DDT8075 and NRS077;
- b) Bare ECCs shall be in accordance with D-DT-3139;
- c) Insulated ECCs shall be in accordance with D-DT-8075;
- d) Bonding leads may be aluminium with a suitable equivalent copper conductor fault current rating; and
- e) A cross sectional drawing of the bonding lead shall be provided. The drawing to indicate all relevant dimensions and material.

#### **3.5 Tests**

- a) Cable and accessories shall be tested in accordance with NRS 077, Eskom instructions 240-170000629, Eskom standard 240-56030640, this standard where applicable; and
- b) Outdoor cable terminations shall be subjected to a natural ageing test at the Koeberg Insulator Pollution Test Site (KIPTS) as minimum. The Engineering instruction titled "Interim insulation pollution standards required in place of KIPTS (240-170000774)" shall apply while the KIPTS test centre is not in operation.

## **3.6 Marking, labelling and packaging**

### **3.6.1 Marking of cable outer sheath and cable conductor**

- a) Cables shall be legibly embossed in accordance with the requirements of NRS 077, but the marking shall include the word 'ESKOM'. A typical legend would be: XXXXXXXX CABLES 2011 76/132 kV IEC 60840 500 mm<sup>2</sup> Al ESKOM;
- b) The cable shall be sequentially marked at one metre intervals with the legend 000 m, 001 m etc. starting with 000 m at the barrel of the drum and finishing with the number indicating the length of cable on the drum at the outer end of the cable. Length marking shall be to an accuracy of better than 1 %;
- c) A proposal and method for marking of cable outer sheath and the cable conductor shall be submitted to Eskom for evaluation. The purpose is to provide asset management information relating to the cable manufacturer, order number, date of manufacture, drum number, conductor identification code range, etc. The proposed method for marking shall meet the following requirements:
  - 1) Cable shall be marked with a unique and traceable identification system. The cable identification system location shall be stated in schedule B;
  - 2) The manufacturer shall keep a secure database of all uniquely marked cables supplied to Eskom;
- d) The cable identification system shall comply with the following minimum requirements:
  - 1) The identification system shall be durable and withstand the expected conditions during the manufacturing processes and operating conditions of the cable over its life;
  - 2) If requested, sufficient proof shall be provided that the identification system offered is chemically compatible with various materials it may be in contact with inside the cable;
  - 3) The identification system shall withstand, without melting or other deleterious effects, continuous conductor operating temperatures of 90°C and short-circuit conductor temperature of at least 250°C;
  - 4) The identification system shall not negatively impact the electrical and mechanical integrity and performance of the cable over its expected life; and
  - 5) The identification system shall not negatively impact the environment in which the cable is installed over its expected life.
- e) The identification code shall consist of any of the following:
  - 1) Alpha-numeric -, alpha - or numeric characters;
  - 2) Eskom name;
  - 3) Eskom logo;
  - 4) Coloured yarn; and
  - 5) Indented marks.
- f) The identification system used shall be visible to the naked eye so as to readily identify that the cable is marked;
- g) The identification code shall be marked (i.e. appear) at intervals not exceeding 500 mm if not continuous in nature. Note: The identification code will therefore be repeated for up to a maximum distance of one meter of cable;
- h) The characters used to uniquely identify the conductor shall be legible with the naked eye without the need for any magnification. The font size offered shall be stated in schedule B;
- i) The algorithm used to generate the identification code shall be unique for each manufacturer;

- j) Details of the proposed cable identification system shall be submitted with the tender documentation; and
- k) The identification system shall be subject to approval by Eskom.

### **3.7 Marking of cable drums**

- a) Cable drums shall be marked as per NRS077 with the following additional information:
  - 1) Cable drums shall be clearly and indelibly marked with the Eskom stock (SAP) number (i.e. 'Eskom SAP Number: XXXXXXXX');
  - 2) All cable drums destined for Eskom shall be branded with the Eskom logo on one of its flat sides (the flange).
    - i. The Eskom logo shall be printed in Eskom blue or black on a white-coloured background;
    - ii. For metal or wooden drums, a portion of the flange surface shall be painted in white to provide a rectangular background on which the signature shall be printed;
    - iii. The height of the white rectangular background shall be three times the diameter of the 'circle' part of the Eskom logo;
    - iv. The printed Eskom logo shall appear centrally on the white rectangular background, leaving a space equal to at least one logo 'circle' before and after the Eskom logo;
    - v. The Eskom logo printing shall be made using a stencil technique or other equivalent techniques which shall be demonstrated to and approved by Eskom; and
    - vi. The dimensions of Eskom logo shall be a minimum length and height of 820 mm and 210 mm respectively. The Eskom logo and standard requirements are shown in Annex A.
  - 3) All other printing on the flange shall be positioned so as to ensure a minimum clearance of one logo circle diameter away from the Eskom logo.

### **3.8 Packaging of cable**

- a) The requirements of NRS077 shall apply;
- b) Specify the treatment of wooden drums to prevent biological attack and wood rot;
- c) Drum life span to be indicated in the technical schedule B;
- d) Routine test report copies shall be provided with each drum of cable supplied; and
- e) Proof of compliance to the standard to which the cable was manufactured to shall be provided with delivery of the cable drum.

### **3.9 Cable Accessory Packaging**

- a) Marking, labelling and packaging of cable accessories shall be in accordance with NRS 077;
- b) In addition to the labelling and packaging the following shall be done:
  - 1) Where applicable, the shelf life of accessory components shall have its expiry dates labelled on the component packaging.
  - 2) In addition, the earliest expiration date of a component shall be stencilled on one outer surface of the packaging.
  - 3) The font size of the stencilled characters shall be a minimum of 10cm.



### 3.10 Spares

Not applicable.

## 4. Authorisation

This document has been seen and accepted by:

Name and surname	Designation
Mfundu Songo	Dx Ops: Planning, GAU, HV Plant: Senior Manager
Queeneth Khumalo	DX Ops Support, HV Plant: Chief Engineer
Neville Booyens	EHV & HV Cable Systems CG: CG Convener

## 5. Revisions

Date	Rev	Compiler	Remarks
July 2022	3	N. Booyens	Revised to current SCOT template; Major revision to align with changes to 240-56030640 where applicable and other detailed requirements added for components of the cable, cable system, cable accessories and cable system accessories as per relevant Eskom standards and NRS077; and Technical schedules A & B added
Aug 2014	2	Q. Khumalo & T Du Plessis	Rev1 published as Rev2. Kept Rev2 for document tracking purposes.
Aug 2014	1	Q. Khumalo & T Du Plessis	Document revised according to the latest Steering Committee of Technologies (SCOT) document template. Document number changed from DSP 34-1625 to 240-56030625.

## 6. Development team

The following people were involved in the development of this document:

- Queeneth Khumalo: Dx Ops Support, HV Plant (Chief Engineer)
- Jacques Paulse: Dx SI WCOU (Senior Engineer)
- Taelo Phali: Dx SI ECOU (Senior Technician)
- Imraan Moolla: Dx NED GOU (Engineer)
- Sandisiwe Mtshaulana: Dx SI GOU (Engineer)
- Deon-Louis Visagie: Dx NED GOU (Senior Engineer)

## 7. Acknowledgements

Not applicable.



## **Annex A – Eskom logo: Printing guide and format** (Normative)

### **1) Eskom logo printing guide and format**

The logo circle ('circle') and the logo word (the word 'Eskom') shall always appear together as one unit.

### **2) Colour specifications**

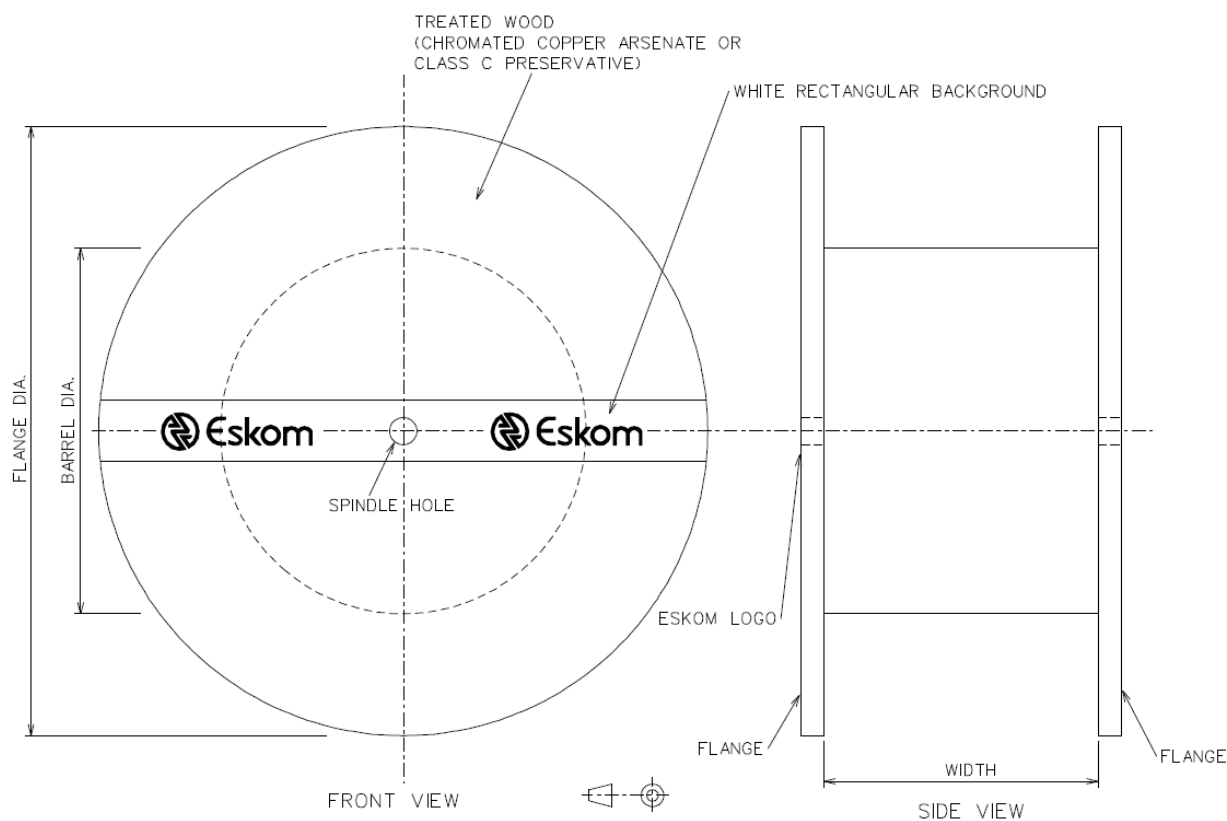
The Eskom logo shall appear in the Eskom corporate blue or in black. The Eskom corporate blue is as follows:

Pantone 287

100%C + 70%M +0%Y +10%K

### **3) Relationship between the logo circle ("circle") and the logo word "Eskom"**

The relationship between the logo "circle" and the logo word 'Eskom' shall always be followed as indicated in the graphic. The measurement between the logo 'circle' and the logo word 'Eskom' is twice the line-width of the 'circle'.



**Figure 1: Typical wooden drum showing Eskom logo branded flange**

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Figure 2: Eskom logo format

**Annex B – Technical schedules A&B Technical schedules A&B**

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
1.			Standard installation conditions			
1.1	240-56030625	3.1 a)	Altitude not exceeding 1800	M	Yes/No	
1.2	240-56030625	3.1 a)	Ambient air temperature	°C	–5 °C to 40 °C (average of 25 °C)	
1.3	240-56030625	3.1 a)	Soil temperature	°C	0 °C to 30 °C (average of 20 °C)	
1.4	240-56030625	3.1 a)	Lightning ground flash density	flashes/km <sup>2</sup> /year	severe (14 flashes/km <sup>2</sup> /year)	
1.5	240-56030625	3.1 a)	solar radiation	W/m <sup>2</sup>	1 000 to 1 250	
1.6	240-56030625	3.1 a)	ultraviolet radiation		High	
1.7	240-56030625	3.1 a)	relative humidity		10 % to 95 %;	
1.8	240-56030625	3.1 a)	wind pressure		not exceeding 700 Pa (equivalent to 34 m/s)	
1.9	240-56030625	3.1 a)	Soil thermal resistivity	K·m/W	1,2	
1.10	240-56030625	3.1.b)	The cable depth of burial as per Eskom DDT 0892. If "No" , specify the depth		Yes	
1.11	240-56030625	3.1.c)	The cable configuration shall be flat or trefoil formation as per DDT 0892		Flat or Trefoil	

Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
1.12	240-56030625	3.1.d)	Cable depth of burial and configuration installation conditions shall be in accordance with D-DT-0891 for direct buried joints and for cable with no joints according to D-DT-0892). If No, specify the depth.		Yes/No	
1.13	240-56030625	3.1.e)	The cable bonding and earthing arrangement shall be in accordance with D-DT-0893. If "No" specify the arrangement.		Yes/No	

Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
2.			Cable and cable accessory rated voltage			
2.1	240-56030625	3.2	Rated voltage of accessories		XXXXXXX	
2.2	240-56030625	3.2	Rated voltage of cable		XXXXXXX	
3.			Cable construction and material			
3.1	240-56030625	3.3.a)	Cable is stranded, circular and compacted		Yes	
3.2	240-56030625	3.3.a)	Cable conductor is Al or Cu		Al/Cu	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
3.3	240-56030625	3.3.a)	Cable conductor cross-sectional area	mm <sup>2</sup>	500, 1000, 1200, 1600, 2000 , 2500	
3.4	240-56030625	3.3.a)	Cable conductor nominal diameter	mm	XXXXXXX	
3.5	240-56030625	3.3.a)	Overall cable nominal diameter	mm	XXXXXXX	
3.6	240-56030625	3.3.b)	Rated continuous current of the cable based on a maximum sustained conductor temperature of 70 °C and 90 °C for cables laid in flat formation as per Eskom DDT 0892	A	XXXXXXX	
3.7	240-56030625	3.3.b)	Rated continuous current of the cable based on a maximum sustained conductor temperature of 70 °C and 90 °C for cables laid in trefoil formation as per Eskom DDT 0892	A	XXXXXXX	
3.8	240-56030625	3.3.b)	Rated continuous current of the cable based on a maximum sustained conductor temperature of 70 °C and 90 °C for cables laid in flat formation with 2D spacing	A	XXXXXXX	
3.9	240-56030625	3.3.b)	Current rating for 24hr with conductor temperature not exceeding 90 °C for cables laid in flat formation as per Eskom DDT 0892	A	XXXXXXX	
3.10	240-56030625	3.3.b)	Current rating for 24hr with conductor temperature not exceeding 90 °C for cables laid in trefoil formation as per Eskom DDT 0892	A	XXXXXXX	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
3.11	240-56030625	3.3.b)	Current rating for 24hr with conductor temperature not exceeding 90 °C for cables laid in flat formation with 2D spacing	A	XXXXXXX	
3.12	240-56030625	3.3.b)	Calculations to support all the ratings assigned provided with all necessary circuit parameters indicated		Yes	
3.13	240-56030625	3.3.c.)	Cable conductor three phase prospective short-circuit current magnitude	kA	40	
3.14	240-56030625	3.3.c.)	Cable conductor three phase prospective short-circuit current duration	sec	1	
3.15	240-56030625	3.3.c.)	Conductor temperature after a symmetrical fault for 1 sec with assuming operation at specified load before fault, in degrees Celsius	°C	XXXXXXX	
3.16	240-56030625	3.3.c.)	Cable conductor single phase to earth prospective short-circuit current magnitude	kA	40	
3.17	240-56030625	3.3.c.)	Cable conductor single phase to earth prospective short-circuit current duration	sec	1	
3.18	240-56030625	3.3.c.)	Sheath temperature after an earth fault for 1 second assuming operation at specified load before fault, in degrees Celsius	°C	XXXXXXX	
3.19	240-56030625	3.3.d.)	Cable conductor three phase prospective short-circuit current magnitude for 3 sec	kA		

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
3.20	240-56030625	3.3.d.)	Cable conductor single phase to earth prospective short-circuit current magnitude for 3 sec	kA		
3.21	240-56030625	3.3.d.)	Conductor temperature after a symmetrical fault for 3 seconds with assuming operation at specified load before fault, in degrees Celsius	°C	XXXXXXX	
3.22	240-56030625	3.3.d.)	Sheath temperature after an earth fault for 3 seconds assuming operation at specified load before fault, in degrees Celsius	°C	XXXXXXX	
3.23	240-56030625	3.3.e)	Longitudinal water block shall be provided in the cable conductor as stated in NRS077		Yes	
3.24	240-56030625	3.3.f)	The conductor screen shall be as per NRS077		Yes	
3.25	240-56030625	3.3.f)	Conductor screen nominal thickness		XXXXXXX	
3.26	240-56030625	3.3.g)	The cable insulation shall be super clean XLPE as per NRS077		Yes	
3.27	240-56030625	3.3.h)	Nominal thickness of insulation		XXXXXXX	
3.28	240-56030625	3.3.h)	The lowest measured thickness of the insulation shall comply to SANS 60840		Yes	
3.29	240-56030625	3.3.i)	Actual conductor screen radial stress at $U_0$	kV/mm	$\leq 8,0$	
3.30	240-56030625	3.3.i)	Actual core screen radial stress at $U_0$	kV/mm	$\leq 4,0$	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
3.31	240-56030625	3.3.j)	The core screen shall comply with the requirements of NRS077		Yes	
3.32	240-56030625	3.3.k)	The cross linking of the core insulation and screens shall be as per NRS077		Yes	
3.33	240-56030625	3.3.l)	The cable shall have a corrugated seamless aluminium sheath and shall comply with the requirements as specified in NRS077		Yes	
3.34	240-56030625	3.3.m)	The corrugated seamless aluminium shall have an earth fault current rating of 40 kA for 1 sec;		Yes	
3.35	240-56030625	3.3.n)	The corrugated seamless aluminium sheath shall provide a radial water block for the cable		Yes	
3.36	240-56030625	3.3.o)	Water penetration test as described in SANS 60840 as per NRS077 submitted		Yes	
3.37	240-56030625	3.3.o)	Provide details of the water barriers		XXXXXXX	
3.38	240-56030625	3.3.p)	Outer sheath shall be applied over the corrugated seamless aluminium sheath		Yes	
3.39	240-56030625	3.3.p)	Outer sheath shall comply to the requirements of NRS077		Yes	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
3.40	240-56030625	3.3.q)	The outer sheath shall have a semi-conductive extruded coating or graphite on the outer sheath layer		Yes	
3.41	240-56030625	3.3.s)	The mass of the cable shall be stated in kg/m	kg/m	XXXXXXX	
3.42	240-56030625	3.3.t)	State the DC resistance of the conductor at 20 °C, in ohms per kilometre ( $\Omega$ /km);	$\Omega$ /km	XXXXXXX	
3.43	240-56030625	3.3.u)	AC resistance of the conductor at 70 °C and 90 °C, in ohms per kilometre ( $\Omega$ /km);	$\Omega$ /km	XXXXXXX	
3.44	240-56030625	3.3.v)	AC resistance of the sheath with the conductor at 70 °C and 90 °C in ohms per kilometre ( $\Omega$ /km	$\Omega$ /km	XXXXXXX	
3.45	240-56030625	3.3.w)	70 °C and 90 °C Reactance per phase when cables are laid in closed trefoil Eskom DDT 0892, in ohms per kilometre ( $\Omega$ /km);	$\Omega$ /km	XXXXXXX	
3.46	240-56030625	3.3.w)	70 °C and 90 °C Reactance per phase when cables are laid in flat formation with 2D spacing in ohms per kilometre ( $\Omega$ /km);	$\Omega$ /km	XXXXXXX	
3.47	240-56030625	3.3.w)	70 °C and 90 °C Reactance per phase when cables are laid in flat formation with spacing as per Eskom DDT 0892, in ohms per kilometre ( $\Omega$ /km);	$\Omega$ /km	XXXXXXX	
3.48	240-56030625	3.3.x)	Capacitance per phase per kilometre	nF/km	XXXXXXX	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
3.49	240-56030625	3.3.y)	70 °C and 90 °C Zero sequence reactance and resistance when cables are laid in closed trefoil Eskom DDT 0892, in ohms per kilometre ( $\Omega/\text{km}$ );	$\Omega/\text{km}$	XXXXXXX	
3.50	240-56030625	3.3.y)	70 °C and 90 °C Zero sequence reactance and resistance when cables are laid in flat formation with 2D spacing in ohms per kilometre ( $\Omega/\text{km}$ );	$\Omega/\text{km}$	XXXXXXX	
3.51	240-56030625	3.3.y)	70 °C and 90 °C Zero sequence reactance and resistance when cables are laid in flat formation with spacing as per Eskom DDT 0892, in ohms per kilometre ( $\Omega/\text{km}$ );	$\Omega/\text{km}$	XXXXXXX	
3.52	240-56030625	3.3.z)	Zero sequence capacitance, per kilometre	nF/km	XXXXXXX	
3.53	240-56030625	3.3.aa)	Conductor losses for the maximum conductor operating temperature	kW/km	XXXXXXX	
3.54	240-56030625	3.3.bb)	Provide a dimensioned drawing of the cable cross-section.		Yes	
3.55	240-56030625	3.3.bb)	The dimensioned drawing of the cable cross section shall indicate the location and type of water barriers used to achieve longitudinal water blocking (including the conductor).		Yes	
3.56	240-56030625	3.3.cc)	Minimum installation bending radius	m	XXXXXXX	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
3.57	240-56030625	3.3.dd)	Emergency current rating (calculated in accordance with SANS 60853-2) of the cable shall be provided	kA	XXXXXXX	
3.58	240-56030625	3.3.ee)	Load profile for cyclic loading			
3.59	240-56030625	3.3.ee)	Cyclic current rating of the cable . This current rating shall be calculated in accordance with SANS 60853-2.			
3.60	240-56030625	3.3.ff)	Cable life expectancy calculations with all circuit parameters shall be given for the standard installation conditions given in this standard for operating temperatures of 70 °C and 90°C shall be done and handed as a tender receivable;		Yes	
3.61	240-56030625	3.3.gg)	Length of cable required	m		
4.			Cable joints			
4.1	240-56030625	3.4.a)	Cable joints without any overhead-line system combination shall be capable of carrying the maximum prospective short circuit fault current of the system for 1 sec without exceeding the temperature specified in NRS 077, assuming a continuous conductor temperature of 70 °C and using an adiabatic calculation.	kA/sec	Min 40kA/1sec	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
4.2	240-56030625	3.4.b)	Cable joints in combination with overhead-line systems shall be capable of carrying the maximum prospective short circuit fault current of the system for 3 sec without exceeding the temperature specified in NRS 077, assuming a continuous conductor temperature of 70 °C and using an adiabatic calculation.	kA/sec		
4.3	240-56030625	3.4.c)	Number of cable joints	each		
4.4	240-56030625	3.4.1.a)	As per NRS077, straight joints and sheath-interrupting joints shall be suitable for jointing the type of cable offered as per this specification.		Yes	
4.5	240-56030625	3.4.1.b)	The joint offered shall have all the necessary materials to restore the cable as per NRS077;		Yes	
4.6	240-56030625	3.4.1.c)	Mechanical torque-shear connectors shall be offered, and these connectors shall be type tested in accordance with SANS 61238-1,		Yes	
4.7	240-56030625	3.4.1.d)	For sheath-interrupting joints the joint shall be able to use single core or concentric bonding lead/s as follows: 1) 185mm <sup>2</sup> or 300 mm <sup>2</sup> copper bonding leads; or 2) 300mm <sup>2</sup> or 500mm <sup>2</sup> for aluminium bonding leads		Yes	
4.8	240-56030625	3.4.1.d)	As per NRS077 it may be assumed that the bonding lead will be terminated at the joint with lugs that have M12 fixing holes.		Yes	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
4.9	240-56030625	3.4.1.e),h)	Per NRS077, specialised tools that are required during the jointing process shall be stated in schedule and made available to purchase		XXXXXXX	
4.10	240-56030625	3.4.1.f)	As per NRS077, the method used to connect the conductors shall be stated and shall be type tested		State method of connection	
4.11	240-56030625	3.4.1.f)	As per NRS077, the method used to connect the conductors shall be stated and shall be type tested		Type tested: Yes/No	
4.12	240-56030625	3.4.1.g)	Joints shall also be offered with an additional option for a two piece coffin box design,		Yes	
4.13	240-56030625	3.4.1.i)	Tender requires installation, if Yes please provide information in 4.14 below		Yes/No	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
4.14	240-56030625	3.4.1.i)	<p>A written confirmation shall be submitted during tender; the written confirmation shall indicate/ state the following:</p> <p>1) The installation of the cable system accessories (joints or terminations) shall be performed by authorised cable jointers (authorised by the cable joint OEM) and shall be supervised by an OEM qualified cable jointer.</p> <p>Or</p> <p>2) The installation of the cable system accessories (joints or terminations) shall be performed by an OEM qualified cable jointer who is authorised to joint/ terminate the offered conductor/cable size and voltage rating. This cable jointer may not be employed by the cable joint OEM.</p>		Indicate which written confirmation shall be provided as applicable	
4.15	240-56030625	3.4.1.j)	A drawing of the joint with dimensions and specific information on drawing as per NRS077 clause 7.1.3 shall be submitted with tender documentation;		Yes	
5.		3.4.2	Cable terminations			
5.1	240-56030625	3.4.a)	Cable terminations without any overhead-line system combination shall be capable of carrying the maximum prospective short circuit fault current of the system for 1 sec without exceeding the temperature specified in NRS 077, assuming a continuous conductor temperature of 70 °C and using an adiabatic calculation.	kA/sec	Min 40kA/1sec	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
5.2	240-56030625	3.4.b)	Cable terminations in combination with overhead-line systems shall be capable of carrying the maximum prospective short circuit fault current of the system for 3 sec without exceeding the temperature specified in NRS 077, assuming a continuous conductor temperature of 70 °C and using an adiabatic calculation.	kA/sec		
5.3	240-56030625	3.4.2	Cable termination whether outdoor or indoor complies with requirements of NRS077		Yes	
5.4	240-56030625	3.4.2.a)	An outdoor termination shall contain all the materials required to complete the termination for all XLPE with CSA metal sheath cable sizes in this document, or for a cable size specified in schedule A		Yes	
5.5	240-56030625	3.4.2.b)	The outdoor termination shall be vertical as per NRS077		Yes	
5.6	240-56030625	3.4.2.c)	Outdoor terminations shall be of the self-supporting or non-self-supporting type		Self-supporting or Non self-supporting	
5.7	240-56030625	3.4.2.d)	Outdoor terminations for 'inland' and 'coastal' shall have a specific creepage of 31 mm/kV.		Yes	
5.8	240-56030625	3.4.2.e)	Outdoor self-supporting terminations shall be of the silicone rubber composite type.		Yes	
5.9	240-56030625	3.4.2.g)	Self-supporting outdoor cable terminations shall be suitable for mounting on the medium equipment support cap shown in D-DT 5271, D-D 5271, D-DT-0890 and D-DT-0890		Yes	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
5.10	240-56030625	3.4.2.h)	Outdoor non-self-supporting terminations for 44 kV shall be of the heat-shrink or cold applied (e.g., the "slip-on") type.		Heat or cold shrink	
5.11	240-56030625	3.4.2.i)	66 kV, 88 kV and 132 kV outdoor terminations shall be self-supporting terminations.		Yes	
5.12	240-56030625	3.4.2.j)	In the case of self-supporting type terminations, unless otherwise specified in Schedule A, the diameter of the tinned copper vertical stem shall be 38 mm		Yes	
5.13	240-56030625	3.4.2.k)	Non-self-supporting (NSS) outdoor cable terminations shall be suitable for mounting on the cable end support structure shown in D-DT-5272, D-DT-5272, D-DT-0890 and D-DT-0890		Yes	
5.14	240-56030625	3.4.2.l)	Non self-supporting terminations shall be supplied with mechanical torque shear connectors		Yes	
5.15	240-56030625	3.4.2.m)	Where self-supporting terminations of the wet type are offered, only cold pouring compounds will be accepted.		Yes	
5.16	240-56030625	3.4.2.n)	In the case of self-supporting type terminations, the termination shall be suitable for a mounting Pitch Circle Diameter (PCD) range between 370 mm and 535 mm.		Yes	
5.17	240-56030625	3.4.2.o)	Environmental sealing for outdoor terminations shall include heat shrink tubes fitted up to the base plate or an alternative method subject to Eskom approval;		Yes, if No Explain the alternative	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
5.18	240-56030625	3.4.2.p)	All outdoor terminations shall be supplied with warning labels to warn operators and members of public of live voltage present on the self-supporting base plate, bonding lead connection and metal bellow. Label to be as per Eskom DDT 3202 SAP no 0172423		Yes	
5.19	240-56030625	3.4.2.q)	Self-supporting outdoor termination bushings may be of the hollow, silicone oil filled type (wet design type), or epoxy cast type (dry design type).		Indicate the type: (wet design type) or epoxy cast type (dry design type).	
5.20	240-56030625	3.4.2.q)	Only composite shed designs shall be allowed for both wet and dry design types		Yes	
5.21	240-56030625	3.4.2.q)	The wet design type without any additional oil reserve tanks shall be preferred		Oil reserve tanks: Yes or No	
5.22	240-56030625	3.4.2.q)	The bonding lead connections for self-supporting outdoor terminations shall always be on the self-supporting base plate, at the bottom.		Yes	
5.23	240-56030625	3.4.2.r)	Non self-supporting outdoor terminations shall be supplied with a leakage current collector		Yes	
5.24	240-56030625	3.4.2.r)	Non self-supporting outdoor terminations shall be supplied with, and a heat-or cold shrink environmental final sealing layer. The cold or heat-shrink anti-track tubing or cold or heat applied sheds shall overlap this final sealing layer. The cold or heat-shrink environmental final sealing layer shall also cover and seal the bonding lead connection if applicable		Yes	

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5.25	240-56030625	3.4.2.s)	SF6 Gas-insulated and oil-immersed terminations shall be as specified by NRS077		Yes	
5.26	240-56030625	3.4.2.t)	GIS/GIL cable and transformer terminations shall be designed in accordance with SANS 62271-209 plug in type A		Yes	
5.27	240-56030625	3.4.2.u)	The exact connection fit shall be ensured by obtaining an interface drawing that is jointly performed and approved by the GIS - , GIL - and / or transformer OEM and the cable termination OEM during the design review phase. Letters shall be submitted during the tender to confirm that such interface drawings will be provided during the design review phase to ensure the correct connection fit and a type tested connection fit method.  interface requirements shall be listed in the technical schedule A& B.		Acknowledge that letters shall be submitted  List the interface requirements	
5.28	240-56030625	3.4.2.v)	The conductor interface connection between the GIS/GIL equipment with the GIS/GIL cable termination shall be agreed upon between the GIS/GIL cable termination OEM and the OEM for the GIS/GIL equipment to be terminated on during the design review phase of a project, after contract award prior to manufacturing. The connection method shall not compromise any type tested design compliance requirements		To be noted and done when required: Acknowledgment of this note required by OEM of termination supplier/OEM	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
5.29	240-56030625	3.4.2.w)	The bonding lead connection for the GIS/GIL cable termination shall be performed with an insulated, metal base plate connection method on the GIS/GIL cable termination. No bonding lead direct connection to the cable CAS or cutting away of the CAS before the cable termination metal bellow shall be allowed.		Yes	
5.30	240-56030625	3.4.2.x)	Environmental sealing for GIS/GIL cable terminations shall include heat or cold shrink tubes fitted up to and onto the insulated metal base plate, or an alternative method subject to Eskom approval		Yes, if No, describe the alternative	
5.31	240-56030625	3.4.2.y)	For installation requirement: a written confirmation shall be submitted during tender; the written confirmation shall indicate/ state the following:  1) The installation of the cable system accessories (joints or terminations) shall be performed by an authorised cable jointers (authorised by the cable joint OEM) and shall be supervised by an OEM qualified cable jointer. Or 2) The installation of the cable system accessories (joints or terminations) shall be performed by an OEM qualified cable jointer who is authorised to joint/ terminate the offered conductor/cable size and voltage rating. This cable jointer may not be employed by the cable joint OEM.		Indicate which written confirmation shall be provided as applicable	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
5.32	240-56030625	3.4.2.z)	A drawing of the termination with dimensions and specific information on drawing as per NRS077 clause 7.1.3 shall be submitted with tender documentation;		Yes	
5.33	240-56030625	3.4.c)	No of terminations required	each		
6.			Link disconnecting boxes			
6.1	240-56030625	3.4.3.a)	Link disconnecting boxes configurations shall be as per NRS077.		Yes	
6.2	240-56030625	3.4.3.a)	Link disconnecting boxes shall be as per Eskom standard 240-56030640		XXXXXXX	
6.3	240-56030625	3.4.3.b)	Link disconnecting boxes shall be as per DDT 8074		Yes	
6.4	240-56030625	3.4.3.b)	Link disconnecting boxes shall be of the structure -, kiosk – and / or manhole type.		XXXXXXX	
6.5	240-56030625	3.4.3.b)	The link disconnecting box shall be provided with insulated tools to install and tighten or loosen and remove link and bonding lead connections;		Yes	
6.6	240-56030625	3.4.3.b)	The link disconnecting box shall be provided with a common applied earth connection method, to bond, earth and short out all link and bonding lead connections to a working earth for maintenance work. Proposals shall be submitted during tender stage for such a design;		Yes	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
6.7	240-56030625	3.4.3.b)	Proposals for voltage measurement methods of the standing voltages and / or circulating current on the bonding leads inside link disconnecting boxes, without the opening of the link disconnecting box enclosure shall be submitted during tender stage;		Yes	
6.8	240-56030625	3.4.3.b)	Link disconnecting boxes (including the stand-off insulators and links) shall have BIL rating as follows: 95 kV (10 positive and 10 negative) phase to earth or in accordance with the insulation co-ordination study requirements			
6.9	240-56030625	3.4.3.b)	Link disconnecting boxes (including the stand-off insulators and links) shall have a power frequency withstand rating as follows: 28kV AC withstand for 1min phase to phase and phase to earth or in accordance with the insulation co-ordination study requirements			
6.10	240-56030625	3.4.3.b)	Link disconnecting boxes (including the stand-off insulators and links) shall have a 40 kA 3 s short circuit test for all link connections forming part of the fault current return path or in accordance with the project specific technical requirements report			
6.11	240-56030625	3.4.3.b)	IP68 or in accordance with the project specific technical requirements report			
6.12	240-56030625	3.4.3.b)	Test proposal for internal arc withstand of a 40kA 1s flashover or connection burn off scenario		XXXXXXX	

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Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
6.13	240-56030625	3.4.3.b)	Installation instructions and torque requirements for the link and bonding lead connections		Yes	
6.14	240-56030625	3.4.3.c)	Link disconnecting boxes shall be as per Eskom DDT 8074		Yes	
6.15	240-56030625	3.4.3.d)	Link disconnecting boxes of the manhole type shall be watertight and shall be suitable for mounting within a link-disconnecting box manhole as shown in D-DT-0894.		Yes	
6.16	240-56030625	3.4.3.e)	The IP rating of the Link disconnecting boxes of the manhole type shall have a degree of protection of IP68 for a 4 m water head as per NRS077.		Yes	
6.17	240-56030625	3.4.3.f)	Three-way disconnecting boxes shall be of the kiosk type as per Eskom DDT 8074 and be suitable for mounting on a cable termination support structure (structure mounted) in accordance with D-DT-5271. The IP rating from NRS077 shall apply.		Yes	
6.18	240-56030625	3.4.3.g)	Antitheft link box standard shall be as per DDT 2874.		Yes	
6.19	240-56030625	3.4.3.h)	The link disconnecting box shall make provision for the connection of the incoming bonding leads from the joints without requiring lugs, i.e. bolted clamps shall be provided. Provision shall also be made for the connection of two additional conductors (i.e. two earth continuity conductors) and a bare copper conductor (i.e. the local earth electrode).		Yes	

Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
6.20	240-56030625	3.4.3.i)	Link disconnecting boxes (i.e. kiosks and manhole/structure box casings and lids) shall be manufactured from 3CR12 stainless steel. The colour of the link disconnecting box shall be 'light grey' (G29 in accordance with SANS 1091) unless otherwise approved by Eskom.		Yes	
6.21	240-56030625	3.4.3.j)	All metal parts of the link disconnecting boxes shall be protected against corrosion in accordance with 240-75655504. The detailed corrosion protection specification shall correspond to a "corrosivity category" of C5 (i.e. "very heavy") in accordance with 240-75655504. The detailed specification (DS) number offered in accordance with 240-75655504 shall be stated in schedule B for all parts of the link disconnecting box.		Specify the DS number	
6.22	240-56030625	3.4.3.k)	A 150 mm x 150 mm x 0.6 mm electrical danger sign in accordance with D-DT-3202 sheet 3 shall be fitted to the front access door of all kiosk type link disconnecting boxes. The sign shall be secured using sublim/blind/aircraft type rivets.		Yes	
6.23	240-56030625	3.4.3.m)	The link disconnecting box shall be provided with a common applied earth connection method, to bond, earth and short out all link and bonding lead connections to a working earth for maintenance work. Proposals shall be submitted during tender stage for such a design.		Yes	

Item	Document	Subclause	Description	UOM	Schedule A	Schedule B
6.24	240-56030625	3.4.3.r)	A design proposal for evaluation and approval for the link disconnecting box must be included that demonstrates that internal arcs shall be minimized.		XXXXXXX	
6.25	240-56030625	3.4.3.u)	Only bottom entry of the bonding leads and ECC shall be allowed for kiosk or structure mounted link disconnecting boxes.		Yes	
6.26	240-56030625	3.4.3.v)	The link disconnecting box designs shall ensure a bonded equipotential earth design. A design whereby the ECC and joint bay earth electrode connection in the link disconnecting box are insulated from the metal enclosure at the entry position and inside the link disconnecting box.		Yes	
6.27	240-56030625	3.4.3.w)	The link disconnecting box for manhole, structure mount and ground mount type shall be fitted with an Eskom evaluated and approved vandal proof locking facility. Provide a design drawing proposal at tender stage for evaluation.		Yes	
6.28	240-56030625	3.4.3.x)	A drawing of the link disconnecting box with dimensions and specific information on drawing as per NRS077 clause 7.1.3 shall be submitted with tender documentation;		Yes	
7.	240-56030625	3.4.4	Sheath voltage limiter surge arrestors.			

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7.1	240-56030625	3.4.4	The SVL rating selection step by step calculations, design and drawings shall be performed for each cable system section earthing and bonding design. The SVL datasheets, type tests and routine tests in accordance with SANS/IEC 60099 shall be submitted as part of any tender offer.		Yes	
7.2	240-56030625	3.4.4	Step by step calculations submitted?		Yes	
7.3	240-56030625	3.4.4	Drawings submitted?		Yes	
7.4	240-56030625	3.4.4	SVL Datasheets submitted?		Yes	
7.5	240-56030625	3.4.4	SVL Type tests submitted in accordance with SANS/IEC 60099?		Yes	
7.6	240-56030625	3.4.4	SVL routine tests submitted in accordance with SANS/IEC 60099?		Yes	
8.			Bonding leads and ECC			
8.1	240-56030625	3.4.5.a)	Bonding leads shall be as per Eskom DDT8075 and NRS077.		Yes	
8.2	240-56030625	3.4.5.b)	Bare ECCs shall be in accordance with D-DT-3139.		Yes	
8.3	240-56030625	3.4.5.c)	Insulated ECCs shall be in accordance with D-DT-8075.		Yes	
8.4	240-56030625	3.4.5.d)	Bonding leads are aluminium or copper		Al/Cu	
8.5	240-56030625	3.4.5.a)	Bonding lead cross-sectional area of the bonding lead offered	mm <sup>2</sup>		

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8.6	240-56030625	3.4.5.d)	Bonding lead prospective system fault level specified without exceeding the maximum temperature stated in IEC 60840.	kA/sec		
8.7	240-56030625	3.4.5.d)	A cross sectional drawing of the bonding lead shall be provided. The drawing to indicate all relevant dimensions and material.		Yes	
9.	240-56030625	3.6	MARKING, LABELLING AND PACKAGING			
9.1	240-56030625	3.6.1.a)& 5.1.b)	Marking of cable outer sheath compliant?		Yes	
9.2	240-56030625	3.6.1.c)	A proposal and method for marking of cable outer sheath shall be submitted to Eskom for evaluation.		Yes	
9.3	240-56030625	3.6.1.c)	A proposal and method for marking of cable outer sheath shall be submitted to Eskom for evaluation		Indicate the supporting information reference of the system to be evaluated	
9.4	240-56030625	3.6.1.c)	A proposal and method for marking of cable conductor shall be submitted to Eskom for evaluation		Yes	
9.5	240-56030625	3.6.1.c)	A proposal and method for marking of cable conductor shall be submitted to Eskom for evaluation		Indicate the supporting information reference of the system to be evaluated	
9.6	240-56030625	3.6.	The cable identification system shall comply with Eskom's minimum and other requirements		Yes	
10.	240-56030625	3.7	Marking of cable drums			
10.1	240-56030625	3.7.a)	Marking of cable drums as per NRS077.		Yes	

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10.2	240-56030625	3.7.a)1), 2)	Compliance to Eskom requirements for marking of cable drums.		Yes	
11.			Packaging of cable and cable accessories			
11.1	240-56030625	3.3.gg)	Length of cable per drum	m	XXXXXXX	
11.2	240-56030625	3.8.a)	Cable drum dimensions as per NRS077		Yes	
11.3	240-56030625	3.8.a)	Cable drum spindle as per NRS077		Yes	
11.4	240-56030625	3.8.a)	Cable drum material		XXXXXXX	
11.5	240-56030625	3.8.b)	Specify the treatment of wooden drum to prevent biological attack and rot		XXXXXXX	
11.6	240-56030625	3.8.c)	Indicate the drum life span			
11.7	NRS 077	6.2.4	Outer end of cable shall be fitted with pulling eye		Yes	
11.8	NRS 077	6.2.4	The pulling eye must seal the cable such as to prevent moisture ingress. The inner end of the cable must be sealed to prevent the moisture ingress.		Yes	
11.9	NRS 077	6.2.5	Provide pulling eye details		Yes	
11.10	NRS 077	6.2.5	Provide maximum pulling eye tension	kN	XXXXXXX	
11.11	NRS 077	6.4	Cable accessories are packed in containers		Yes	
11.12	NRS 077	6.4	Indicate the accessory container material		XXXXXXX	

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11.13	NRS 077	6.4	Where more than one crate is used per accessory are the containers sequentially marked with a crate number with font of minimum 50 mm		Yes	
11.14	NRS 077	6.4	Accessory components that can be damaged are packed in hermetically sealed bags.		Yes	
11.15	NRS 077	6.4	All components that make up the accessory are individually marked and referenced on the bill of material that is supplied with the accessory		Yes	
11.16	NRS 077	6.4	Accessory crates are clearly marked with a durable label that lists the contents of the crate		Yes	
11.17	NRS 077	6.4	Does the accessory come with a bill of materials and installation instruction		Yes	
11.18	240-56030625	3.9.b)	Where applicable, the shelf life of accessory components shall have its expiry dates labelled on the component packaging. In addition, the earliest expiration date of a component shall be stencilled on one outer surface of the packaging. The font size of the stencilled characters shall be a minimum of 10cm.		Yes	
11.19	NRS 077	7.2.1	Routine test report copies shall be provided with each drum of cable supplied		Yes	
11.20	NRS 077	7.2.2	Proof of compliance to the standard to which the cable was manufactured to shall be provided with delivery of the cable drum		Yes	

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12.	240-56030625	3.5.a)	Tests - Cable and accessories shall be tested in accordance with NRS 077, Eskom instruction 240-170000629, 170000774, Eskom standard 240-56030640, and this standard where applicable.		Yes	
12.1	NRS 077		Test voltages must be as per NRS077		Yes	
12.2	240-56030625	3.5.b)	Outdoor cable terminations shall have the pollution type tests performed as per Eskom 240-170000774.		Yes	
Signatures						
Supplier	Name(Print)		Sign		Date:	
Factory	Name(Print)		Sign		Date:	
Eskom	Name(Print)		Sign		Date:	

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