

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

Unique Identifier: **240-56030625**

Alternative Reference Number: **DSP 34-1625**

Area of Applicability: **Engineering**

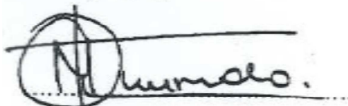

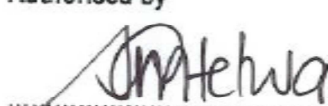
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Compiled by  Queeneth Khumalo Senior Engineer: Cable Systems Date: <u>31 July 2014</u>	Approved by  Neville Booyens Convener: HV Cable systems CG Date: <u>01/08/2014</u>	Authorised by  Sidwell Mtetwa Acting Senior Manager: H1 Plant Date: <u>04/08/2014</u>
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Approved by CS&MES SC



Thinus du Plessis

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Date: 04/09/2014

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CONTROLLED DISCLOSURE

When downloaded from the EDMS, this document is uncontrolled and the responsibility rests with the user to ensure it is in line with the authorised version on the system.

1. INTRODUCTION

This specification has been compiled in order to promote the standardization, rationalization and testing of High-voltage (HV) Cross-linked Polyethylene (XLPE) insulated power cables and accessories for the Eskom Distribution and Transmission Division. 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 minimize the risk of this occurring, the Distribution Division has undertaken to only purchase HV cable and accessories that have been type tested as a system in accordance with SANS 60840.

1.1 SCOPE

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

1.1.1 Purpose

The document is a standard to be implemented in the designing of HV cable networks in Eskom.

1.1.2 Applicability

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

1.2 NORMATIVE 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.

1.2.1 International documents

- [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

1.2.2 Eskom national documents

- [6] DSP 34-1658: Distribution Standard Part 4: Corrosion Protection Specification for New Indoor and Outdoor Distribution Equipment Manufactured from Steel
- [7] D-DT-5271 sheet 1 of 3: HV cable termination - support structure foundation
- [8] D-DT-5271 sheet 2 of 3: HV cable termination - support structure details
- [9] D-DT-5271 sheet 3 of 3: HV cable termination - support cap details
- [10] D-DT-5272 sheet 1 of 3: HV cable end support (non self-supporting) steelwork assembly details
- [11] D-DT-5272 sheet 2 of 3: HV cable end support (non self-supporting) steelwork surge arrester mounting plate
- [12] D-DT-5272 sheet 3 of 3: HV cable end support (non self-supporting) foundation details
- [13] D-DT-0890 sheet 1 of 4: HV XLPE cable termination with surge arrester conductor assembly

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- [14] D-DT-0890 sheet 2 of 4: HV XLPE cable termination with surge arrester overhead line assembly
- [15] D-DT-0890 sheet 3 of 4: HV XLPE cable termination (non self supporting) with surge arrester conductor assembly
- [16] D-DT-0890 sheet 4 of 4: HV XLPE cable termination (non self supporting) with surge arrester overhead line assembly
- [17] D-DT-0891 sheet 1 of 4: HV XLPE single circuit direct buried joint bay layout
- [18] D-DT-0892 sheet 1 of 3: HV power cable trench details (flat formation)
- [19] D-DT-0892 sheet 2 of 3: HV power cable trench details (tre-foil formation)
- [20] D-DT-0893 sheet 1 of 5: HV cable bonding and earthing arrangement end-point bonded system
- [21] D-DT-0893 sheet 2 of 5: HV cable bonding and earthing arrangement double end-point bonded system
- [22] D-DT-0893 sheet 3 of 5: HV cable bonding and earthing arrangement multiple end-point bonded system
- [23] D-DT-0893 sheet 4 of 5: HV cable bonding and earthing arrangement cross-bonded system
- [24] D-DT-0893 sheet 5 of 5: HV cable outdoor termination bonding and earthing arrangement
- [25] D-DT-0894: HV cable link disconnecting box manhole details
- [26] D-DT-3202: Danger signs
- [27] D-DT-8070: HV cable
- [28] D-DT-8071: HV cable joints
- [29] D-DT-8072: HV cable terminations
- [30] D-DT-8073: HV cable termination supports
- [31] D-DT-8074: HV cable link disconnecting boxes
- [32] D-DT-8075: Bonding leads for HV cables

1.3 INFORMATIVE REFERENCES

- [33] 32-9: Definition of Eskom Documents
- [34] 32-644: Eskom Documentation Management Standard
- [35] 474-65: Operating Manual of the Steering Committee of Wires Technologies (SCOWT)

1.4 DEFINITIONS

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

1.4.1 Classification

Controlled Disclosure: Controlled Disclosure to external parties (either enforced by law, or discretionary)

1.5 ABBREVIATIONS

The abbreviations in NRS 077 and the following shall apply:

Abbreviation	Explanation
AC	Alternating Current
CAP	Committee for Accepted Products
HV	High Voltage

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LAP	List of Accepted Products
n/a	not applicable
NSS	Non-self-supporting
PCD	Pitched Circle Diameter
SCOT	Steering Committee of Technologies
SCOWT	Steering Committee of Wires Technologies
SI	Standards Implementation
XLPE	Cross-linked Polyethylene

1.6 ROLES AND RESPONSIBILITIES

Not applicable.

1.7 PROCESS FOR MONITORING

Not applicable.

1.8 RELATED/SUPPORTING DOCUMENTS

Not applicable.

2. REQUIREMENTS

2.1 GENERAL

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

2.1.1 Standard installation conditions

The standard installation conditions given in NRS 077 shall apply. In addition, the cable depth of burial and configuration installation conditions shall be in accordance with (D-DT-0891 sheet 1 of 4, D-DT-0892 sheet 1 of 3 and D-DT-0892 sheet 2 of 3). The cable bonding and earthing arrangement (special bonding) shall be in accordance with D-DT-0893 sheet 1 of 5, D-DT-0893 sheet 2 of 5, D-DT-0893 sheet 3 of 5, D-DT-0893 sheet 4 of 5 and D-DT-0893 sheet 5 of 5.

Note: The rated current of the cable is to be based on a maximum sustained 'normal' 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.

2.1.2 Standardized cable, cable accessories and ancillary equipment

2.1.2.1 Standardized cable, accessories and ancillary equipment for use on HV systems in Eskom Distribution are given in the Buyer's Guide drawings listed in paragraph 2.1.3.

2.1.2.2 The cable conductor shall be stranded and compacted aluminium in accordance with NRS 077, unless otherwise specified in Schedule A and as per project specific requirements engineering reports issued by Group Technology HV Plant department.

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- 2.1.2.3** The conductor cross-sectional area shall be either 500 mm² or 1 000 mm², unless otherwise specified in Schedule A and as per project specific requirements engineering reports issued by Group Technology HV Plant department.

Notes: 1. The most common sizes of HV cable installed in Eskom Distribution networks are 500 mm² and 1 000 mm². These sizes have therefore been chosen as the standard sizes. Rationalization of conductor size is required to limit the stock holding of both cables and accessories.

2. Use of bigger conductor sizes and other conductor material is mostly restricted to Eskom Transmission substation applications, and only in special cases for Eskom Distribution applications.

2.2 ADDITIONAL SPECIFIC REQUIREMENTS

2.2.1 Cable materials and construction

The cable shall have a corrugated aluminium metal sheath for underground installations, unless otherwise specified in Schedule A and as per project specific requirements engineering reports issued by Group Technology HV Plant department.

2.2.2 Cable joints

Where mechanical torque-shear connectors are offered, the connectors shall be type tested in accordance with SANS 61238-1, joints and terminations where applicable shall be type tested with the connectors offered.

2.2.3 Outdoor cable terminations

2.2.3.1 Self-supporting outdoor cable terminations shall be suitable for mounting on the medium equipment support and cap shown in D-DT 5271 sheet 2 of 3, D-D 527 sheet 3 of 3, D-DT-0890 sheet 1 of 4 and D-DT-0890 sheet 2 of 4.

2.2.3.2 Non-self-supporting (NSS) outdoor cable terminations shall be suitable for mounting on the cable end support structure shown in D-DT-5272 sheet 1 of 3, D-DT-5272 sheet 2 of 3, D-DT-0890 sheet 3 of 4 and D-DT-0890 sheet 4 of 4.

2.2.3.3 Outdoor terminations for 'inland' and 'coastal' applications shall comply with the requirements for 'medium' and 'very heavy' pollution conditions respectively in accordance with NRS 077; unless otherwise specified in schedule A and as per project specific requirements engineering reports issued by Group Technology HV Plant department.

2.2.3.4 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.

2.2.3.5 NSS terminations shall be supplied with mechanical torque shear connectors that have an M16 fixing hole.

2.2.3.6 Outdoor self-supporting terminations shall be of the composite type. The material offered shall be stated in Schedule B.

2.2.3.7 Where self-supporting terminations of the wet type are offered, only cold pouring compounds will be accepted.

2.2.3.8 In the case of self-supporting type terminations, the termination shall be suitable for a mounting Pitched Circle Diameter (PCD) range between 370 mm and 535 mm.

2.2.4 Link disconnecting boxes and sheath voltage limiter surge arrestors

2.2.4.1 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.

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2.2.4.2 Three-way link disconnecting boxes of the manhole type shall also be suitable for mounting on a cable termination support structure (structure mounted) in accordance with D-DT-5271 sheet 2 of 3.

Note: The mounting dimensions provided for structure-mounted link disconnecting boxes in accordance with D-DT-5271 sheet 2 of 3 are as follows: horizontal fixing centres = 530 mm; vertical fixing centres = 250 mm; M16 (18 mm) × 118 mm vertical slots.

2.2.4.3 Link disconnecting boxes (i.e. kiosks and manhole/structure box casings and lids) shall be manufactured from stainless steel. The colour of the link disconnecting box shall be 'light grey' (G29 in accordance with SANS 1091) unless otherwise approved by Eskom.

2.2.4.4 All exposed metal of link disconnecting boxes shall be protected against corrosion in accordance with DSP 34-1658. The corrosion protection system (i.e. the equivalent detailed specification 'DS' number in accordance with DSP 34-1658) offered by the manufacturer shall be stated in Schedule B.

2.2.4.5 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 sublime/blind/aircraft type rivets.

2.2.5 Bonding leads

Unless the prospective earth fault current requires a larger conductor, the conductor cross-sectional area of the bonding leads shall be 185 mm² (refer to D-DT-8075).

3. TESTS

Cable and accessories shall be tested in accordance with NRS 077.

4. MARKING, LABELING AND PACKAGING

Marking, labelling and packaging shall be in accordance with NRS 077.

4.1 MARKING OF CABLE OUTER SHEATH

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:

XXXXXXXXX CABLES 2011 76/132 kV IEC 60840 500 mm² Al ESKOM

4.2 MARKING OF CABLE DRUMS

In addition to requirements of NRS 077, cable drums shall be clearly and indelibly marked with the Eskom stock (SAP) number (i.e. 'Eskom SAP Number: XXXXXXXX').

All HV cable drums destined for Eskom shall be branded with the Eskom logo on one of its flat sides (the flange). The Eskom logo shall be printed in Eskom blue or black on a white-coloured background. 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. The height of the white rectangular background shall be three times the diameter of the 'circle' part of the Eskom logo. 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. The Eskom logo printing shall be made using a stencil technique or other equivalent techniques which shall be demonstrated to and approved by Eskom. 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.

All other printing on the flange shall be positioned so as to ensure a minimum clearance of one logo circle ('circle') diameter away from the Eskom logo.

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5. DOCUMENTATION

Documentation shall be in accordance with NRS 077. 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).

5.1 ADDITIONAL INFORMATION TO BE PROVIDED AT TENDER STAGE

5.1.1 Cable

The following information regarding the cable offered (in addition to that specified in NRS 077) shall be provided in Schedule B:

- The alternating current (ac) resistance of the conductor at 70 °C and 90 °C, in ohms per kilometre (Ω/km).
- The ac resistance of the sheath with the conductor at 70 °C and 90 °C, in ohms per kilometre (Ω/km).
- The zero sequence resistance and reactance laid in close trefoil and laid flat at 70 °C and 90 °C, in ohms per kilometre (Ω/km).
- The rated continuous current at 70 °C and 90 °C.
- Dimensioned drawings of the bonding lead cross-sections.
- The cable ampacity current rating calculations at 70 °C and 90 °C for standard installation conditions as per D-DT 0892.
- The cable life expected life time calculations.

5.1.2 Circuit parameters

All circuit parameters shall be given for the standard installation conditions given in paragraph 2.1.1.

6. SPARES

The length of cable and number and type of accessories to be supplied shall be specified in Schedule A.

Note: HV cables and accessories are classified as strategic spares in the Eskom Distribution and Transmission Division.

7. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
Sidwell Mtetwa	Acting Senior HV Plant Manager
Vinod Singh	Middle Manager DBOUS

8. REVISIONS

Date	Rev.	Compiler	Paragraph	Remarks
Aug 2014	1	Q. Khumalo & T Du Plessis	None	<ul style="list-style-type: none">Document revised according to the latest Steering Committee of Technologies (SCOT) document template.Document number changed from DSP 34-1625 to 240-56030625.

9. DEVELOPMENT TEAM

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

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- Thinus du Plessis: Chief Engineer
- Queeneth Khumalo: Senior Engineer

10. ACKNOWLEDGEMENTS

The author acknowledges the contribution of Rhett Kelly and the development team that was involved in the development of the original specification DSP 34-1625. The development team consisted of the following members: Rhett Kelly, Thinus du Plessis, Brighton Mwarehwa and Greg Whyte.

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

A.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.

A.1.1 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

A.1.2 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'.

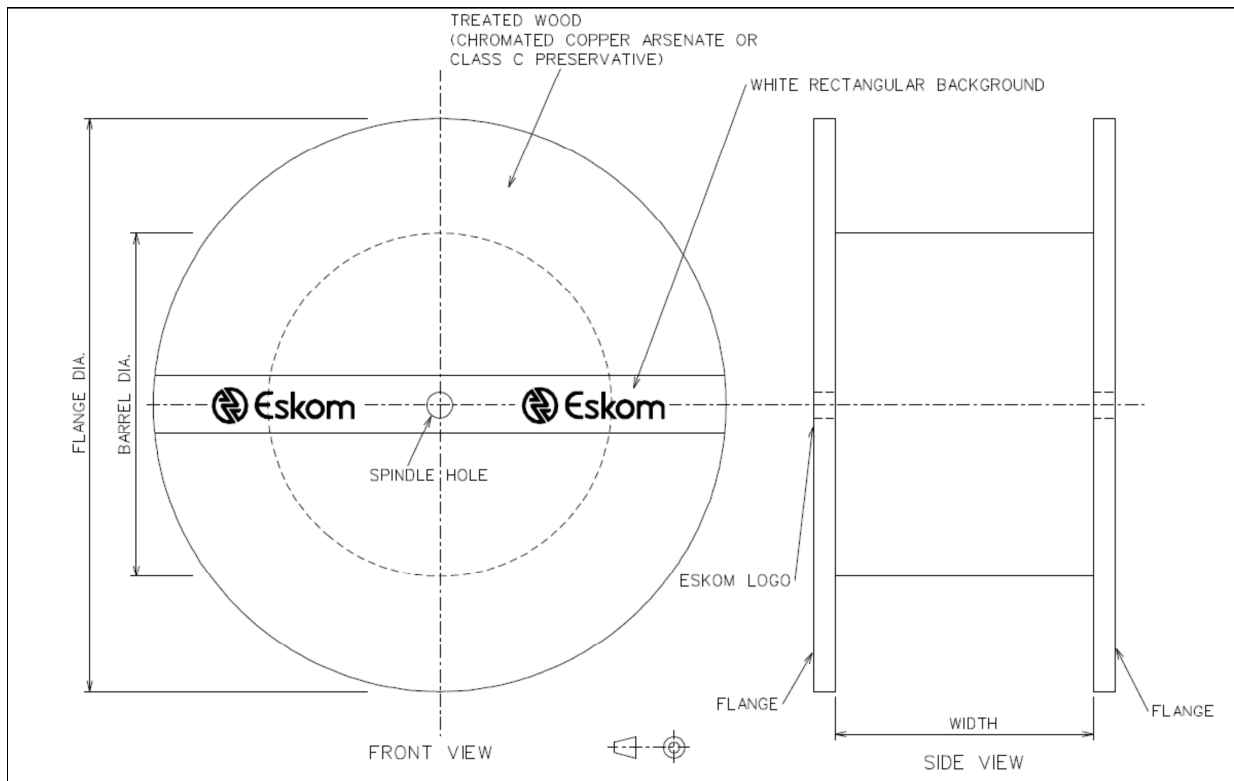


Figure 1: Typical wooden drum showing Eskom logo branded flange

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Figure 2: Eskom logo format

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Annex B– Impact Assessment (Normative)

Impact assessment form shall be completed for all documents.

B.1 Guidelines

- All comments must be completed.
- Motivate why items are N/A (not applicable)
- Indicate actions to be taken, persons or organisations responsible for actions and deadline for action.
- Change control committees to discuss the impact assessment, and if necessary give feedback to the compiler of any omissions or errors.

B.2 Critical points

B.2.1 Importance of this document. E.g. is implementation required due to safety deficiencies, statutory **requirements, technology changes, document revisions, improved service quality, improved service** performance, and optimised costs.

Comment: Implementation of the document is required due to various standard updates. Changes and additional information provided – see revision control sheet.

B.2.2 If the document to be released impacts on statutory or legal compliance - this need to be very clearly stated and so highlighted.

Comment: n/a.

B.2.3 Impact on stock holding and depletion of existing stock prior to switch over.

Comment: Not applicable as no new stock items were created.

B.2.4 When will new stock be available?

Comment: Not applicable as no new stock items were created.

B.2.5 Has the interchangeability of the product or item been verified - i.e. when it fails is a straight swop possible with a competitor's product?

Comment: Not applicable as no new stock items were created

B.2.6 Identify and provide details of other critical (items required for the successful implementation of this document) points to be considered in the implementation of this document.

Comment: n/a

B.2.7 Provide details of any comments made by the Regions regarding the implementation of this document.

Comment: n/a.

B.3 Implementation timeframe

B.3.1 Time period for implementation of requirements.

Comment: Immediate

B.3.2 Deadline for changeover to new item and personnel to be informed of DX wide change-over.

Comment: n/a

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B.4 Buyers Guide and Power Office

B.4.1 Does the Buyers Guide or Buyers List need updating?

Comment: No new items have been created.

B.4.2 What Buyer's Guides or items have been created?

Comment: None.

B.4.3 List all assembly drawing changes that have been revised in conjunction with this document.

Comment: None.

B.4.4 If the implementation of this document requires assessment by CAP, provide details under B.4.5

B.4.5 Which Power Office packages have been created, modified or removed?

Comment: None

B.5 CAP / LAP Pre-Qualification Process related impacts

B.5.1 Is an ad-hoc re-evaluation of all currently accepted suppliers required as a result of implementation of this document?

Comment: No.

B.5.2 If NO, provide motivation for issuing this specification before Acceptance Cycle Expiry date.

Comment: Revised in accordance with the revision cycle.

B.5.3 Are ALL suppliers (currently accepted per LAP), aware of the nature of changes contained in this document?

Comment: Yes

B.5.4 Is implementation of the provisions of this document required during the current supplier qualification period?

Comment: Yes.

B.5.5 If Yes to B.5.4, what date has been set for all currently accepted suppliers to comply fully?

Comment: Immediate.

B.5.6 If Yes to B 5.4, have all currently accepted suppliers been sent a prior formal notification informing them of Eskom's expectations, including the implementation date deadline?

Comment: Suppliers are already aware of the documents requirements.

B.5.7 Can the changes made, potentially impact upon the purchase price of the material/equipment?

Comment: No.

B.5.8 Material group(s) affected by specification: (Refer to Pre-Qualification invitation schedule for list of material groups)

Comment: HV cables, HV cable accessories and HV ancillary equipment.

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B.6 Training or communication

B.6.1 Is training required?

Comment: No. (if no; then B.6.2 to B.6.6 will be n/a)

B.6.2 State the level of training or communication required to implement this document. (E.g. none, communiqués awareness training, practical / on job, module, etc.)

Comment: n/a.

B.6.3 State designations of personnel that will require training.

Comment: n/a.

B.6.4 Is the training material available? Identify person responsible for the development of training material.

Comment: n/a

B.6.5 If applicable, provide details of training that will take place. (e.g sponsor, costs, trainer, schedule of training, course material availability, training in erection / use of new equipment, maintenance training, etc).

Comment: n/a

B.6.6 Was Training & Development Section consulted w.r.t training requirements?

Comment: n/a.

B.7 Special tools, equipment, software

B.7.1 What special tools, equipment, software, etc will need to be purchased by the Region to effectively implement?

Comment: None.

B.7.2 Are there stock numbers available for the new equipment?

Comment: No new equipment specified.

B.7.3 What will be the costs of these special tools, equipment, software?

Comment: n/a

B.8 Finances

B.8.1 What total costs would the Regions be required to incur in implementing this document? Identify all cost activities associated with implementation, e.g. labour, training, tooling, stock, obsolescence

Comment: n/a

Impact assessment completed by:

Name: Queeneth Khumalo

Designation: Senior Engineer

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