

 Eskom	Standard	Transmission
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Title: **SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED SWITCHGEAR RATED FOR VOLTAGES 1 KV AND ABOVE – OUTDOOR DISCONNECTORS AND EARTHING SWITCHES**

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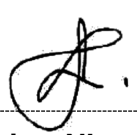



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Content

	Page
1. Introduction	5
2. Supporting clauses	5
2.1 Scope	5
2.1.1 Purpose	5
2.1.2 Applicability	5
2.2 Normative/informative references	6
2.2.1 Normative	6
2.2.2 Informative	7
2.3 Definitions	8
2.3.1 General	8
2.3.2 Disclosure classification	12
2.4 Abbreviations	12
2.5 Roles and responsibilities	12
2.6 Process for monitoring	13
2.7 Related/supporting documents	13
3. Specification for High Voltage Air Insulated Switchgear rated for Voltages 1 kV and above – Outdoor Disconnectors and Earthing Switches	13
3.1 Ratings	13
3.1.1 Rated voltage (U_r) and number of phases	13
3.1.2 Rated insulation levels	14
3.1.3 Rated frequency (f_r)	15
3.1.4 Rated continuous (normal) current (I_r) and temperature rise	15
3.1.5 Rated short-time withstand current (I_k)	16
3.1.6 Rated peak withstand current (I_p)	17
3.1.7 Rated duration of short-circuit (t_k)	17
3.1.8 Rated supply voltage of closing and opening devices and of auxiliary and control circuits (U_a)	18
3.1.9 Rated short-circuit making current (I_{ma}) of the Earthing Switch	18
3.1.10 Rated contact zone	19
3.1.11 Rated Mechanical Terminal Load	19
3.1.12 Classification of Mechanical Endurance of the disconnector	19
3.1.13 Classification of Mechanical Endurance of the earthing switches	19
3.1.14 Rated ice-coating	20
3.1.15 Rated values of disconnectors for bus-transfer current switching	20
3.1.16 Classification and rated values of earthing switches Induced current switching	20
3.1.17 Classification and rated values of disconnectors for bus-charging current switching	21
3.2 Design and construction	21
3.2.1 Design, Component and Material Changes	21
3.2.2 Service conditions	21
3.2.3 General	22
3.2.4 Construction requirements	23
3.2.5 Type of disconnector	23
3.2.6 Earthing switch	24
3.2.7 Mechanical and physical features	24
3.2.8 Operation Interlocks between Disconnector and Earthing Switch	28

**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**

Revision: **1**

Page: **3 of 91**

3.2.9	Nameplates	29
3.2.10	Operating Labels.....	30
3.2.11	Operating mechanisms	30
3.2.12	Auxiliary and control equipment and circuitry	33
3.2.13	Enclosures requirements	36
3.2.14	Corrosion protection and lubrication	40
3.2.15	Disconnecter and earthing switch support structure and foundation	40
3.2.16	Electro-Magnetic Compatibility (EMC)	42
3.2.17	Requirements in respect of the isolating distance of disconnectors	42
3.2.18	Mechanical Strength	42
3.2.19	Securing of Position	42
3.2.20	Additional Requirements for Power-operated Mechanisms	42
3.2.21	Indication and Signalling of Position	42
3.2.22	Maximum Force Required for Manual Operation of motor-operated disconnectors	43
3.2.23	Dimensional Tolerances	44
3.2.24	Working Clearances and Personnel Safety	44
3.2.25	Drawings	45
3.2.26	Documentation requirements.....	46
3.3	Tests.....	49
3.3.1	General	49
3.3.2	Type and routine test requirements	50
3.3.3	Tests after installation on site (pre-commissioning tests).....	54
3.4	Design reviews, Manufacturing, Transport, Storage, Installation, pre-Commissioning and After-sales Technical Support	54
3.4.1	Design Reviews inspection (factory visit) and factory Acceptance testing (FAT).....	54
3.4.2	General	55
3.4.3	Inspection of manufacturing facilities and disconnector and/ earthing earthing switch	55
3.4.4	Conditions during transportation	56
3.4.5	Transportation and off-loading	56
3.4.6	Packaging, storage and preservation requirements	56
3.4.7	Installation	58
3.4.8	Pre-commissioning and onsite work requirements	60
3.4.9	Safety related data (where applicable)	62
3.4.10	Requirements for pressure vessels (where applicable)	62
3.4.11	After sales technical support.....	62
3.5	Inspection and maintenance	62
3.5.1	General	62
3.5.2	Maintenance Digital Video recording	64
3.5.3	Tools and spares	65
3.5.4	Spares	65
3.5.5	Modifications to disconnectors and earthing switches during their service life	67
3.5.6	Condition monitoring of disconnectors and earthing switches.....	67
3.6	OEM Operation and Maintenance Instruction Manuals	68
3.6.1	General	68
3.6.2	Content.....	68
3.7	Training	70
3.8	Safety, health, environment, and quality	71
3.9	Technical submission minimum tender returnables	71
3.9.1	Minimum tender returnables of the offered disconnector and earthing switch	71

ESKOM COPYRIGHT PROTECTED

3.9.2 Minimum tender returnables of the offered electronic	71
4. Authorization.....	71
5. Revisions	72
6. Development team	72
7. Acknowledgements	72
Annex A – Supplier and Eskom Transmission responsibilities.....	73
Annex B – Technical Schedule A & B (Generic typical example)	77
Annex C – Material and Corrosion Protection information	80
Annex D – Drawings – Outline and General Arrangement.....	81
Annex E – Switchgear Training requirements from OEM.....	88
1. Switchgear Training from Suppliers and their OEM's	88

Figures

Figure 1: Auxiliary switch contacts timing diagram.....	36
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Tables

Table 1: Rated voltage and insulation levels	14
Table 2: Standardised rated normal currents (I_n)	15
Table 3: Standardised rated short circuit-breaking, short-time and peak withstand currents	17
Table 4: Classification of disconnectors for mechanical endurance	19
Table 5: Classification of earthing switches for mechanical endurance	20
Table 6: Test Standards or Methods applicable for heavy to very heavy pollution site severity	27
Table 7: Eskom Transmission standard wiring interface drawings for disconnectors and earthing switches.....	33
Table 8: Minimum electrical working clearances	44
Table C1: Material and Corrosion Protection Information	80
Table D2: Eskom Transmission standard drawings for outdoor disconnectors and earthing switches steel support structures which are in line with Eskom Transmission civil foundations	81

1. Introduction

This standard specification sets out Eskom Transmission's specific and standardised requirements for outdoor air-insulated disconnectors and earthing switches for use in three-phase 50 Hz alternating current systems with nominal voltages from 6,6 kV up to and including 765 kV. Where ratings are suitable, this disconnectors and earthing switches will also be used in other applications such as HVDC conversion or inversion substations. The requirements for disconnectors and earthing switches are based on SANS 62271-102 (High-voltage disconnectors). The "equipment" hereinafter mentioned refers to disconnectors (isolators) as well as earthing switches forming combined units with disconnectors (isolators) or separately mounted earthing switches as applicable. The terminology "disconnectors" and "earthing switches" is mainly used in this standard.

This standard specification includes the devices that are specified with the disconnectors and earthing switches, namely the electronic digital online condition monitoring and/or integrated diagnostic devices. The type tested ratings of the disconnectors and earthing switches as well as their associated accessories are required to remain valid for the life-expectancy (minimum 40 years) specified herein, not unless the particular test has been qualified its validity for a specific period.

This standard specification is also used to specify the disconnector and earthing switch of the gas insulated switchgear and mixed technology switchgear, where applicable. For special application switchgear requirements and/or unique projects, a separate standard specification shall be issued for use e.g. for disconnecting circuit-breaker (DCB) (240-105506460), etc. Such requirement will be issued with separate Technical Schedules A and B in accordance with their technical standard specifications.

2. Supporting clauses

2.1 Scope

This is the Eskom Transmission standard specification for disconnectors and earthing switches.

2.1.1 Purpose

The purpose of this standard is to provide a basic standard for outdoor air insulated disconnector and earthing switches.

This standard specification provides the specific and standardised requirements for outdoor air-insulated disconnectors and earthing switches in accordance with SANS 62271-102. The disconnectors and earthing switches are intended for use in substations having three-phase 50 Hz alternating current (a.c.) nominal operating voltages from 6,6 kV up to and including 765 kV. Disconnectors and earthing switches are required for the specific and standardised requirements. Where ratings are suitable, this disconnectors and earthing switches will also be used in other applications such as HVDC conversion or inversion substations

This standard specification covers preferred ratings; construction and testing requirements; and application, loading, installation, operation, and maintenance guidelines for all high-voltage outdoor air switches rated in excess of 1000 V. This includes such switch types as disconnectors and earthing switches for manual or power operation. The standard specification addresses design, manufacture, testing, supply, delivery, storage, installation (erection), pre-commissioning tests, operation and maintenance training of outdoor type disconnectors, earthing switches and associated equipment specified herein.

A set of technical schedules A and B accompanies this standard specification, which are as per Annex B (Generic). Additional and special requirements are also included in Schedule A.

2.1.2 Applicability

This document shall apply throughout Eskom Transmission.

2.2 Normative/informative references

Parties using this document shall apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

NOTE: IEC standards (including IEC documents adopted as SANS standards without changes)

- [1] ISO 9001, Quality Management Systems.
- [2] Occupation Health and Safety Act (OHS Act) No 85 of 1993 – Construction and Electrical Machinery Regulations
- [3] 240-114967625, Operating Regulations for High Voltage Systems (ORHVS).
- [4] 240-56063765, Eskom Health and Safety management – Supplier requirements.
- [5] SANS/ IEC 60050(441):1984: International Electrotechnical Vocabulary – Chapter 441: Switchgear, controlgear and fuses
- [6] SANS 62271-1, High-voltage switchgear and controlgear – Part 1: Common specifications.
- [7] SANS 62271-102, High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches.
- [8] SANS 62271-203, High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV.
- [9] SANS 60265-1, High-voltage switches – Part 1: Switches for rated voltages above 1 kV and less than 52 kV.
- [10] SANS 62271-104, High-voltage switches – Part 2: High-voltage switches for rated voltages of 52 kV and above.
- [11] SANS 62271-301, High-voltage switchgear and controlgear – Part 302: Dimensional standardisation of high-voltage terminals.
- [12] SANS 121 (ISO 1461) Hot-dip galvanised coatings on fabricated iron and steel articles – Specifications and test methods
- [13] SANS 62262, Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code).
- [14] SANS 60529, Degrees of protection provided by enclosures (IP code)
- [15] SANS 60273, Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1 000 V.
- [16] SANS 60168, Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1 000 V.
- [17] SANS 60137, Insulated bushings for voltages above 1000V.
- [18] SANS 60060-1, High-voltage test techniques — Part 1: General definitions and test requirements.
- [19] IEC 60073, Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators
- [20] IEC 60447, Basic and safety principles for man-machine interface, marking and identification – Actuating principles
- [21] SANS 60815-1:2009, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles.
- [22] SANS 60815-2:2009, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 2: Ceramic and glass insulators for a.c. systems.

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- [23] SANS 60815-3:2009, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems.
 - [24] 240-142598739 Rev 3, ...Guidance on technical Standards applicable for pollution related qualification of High Voltage equipment (internal Eskom Transmission Engineering Instruction)
 - [25] SANS 1091, National colour standard.
 - [26] 240-75655504, Corrosion protection standard for new indoor and outdoor Eskom equipment, components, materials and structures manufactured from steel
 - [27] 240-120804300, Standard for the Labelling of High Voltage Equipment
 - [28] 240-62629353, Specification for Panel Labelling standard
 - [29] 240-64636794, Standard for Wiring and Cable Marking
 - [30] IEC 61850/ SANS 61850 (All parts) Communication networks and systems for power utility automation
 - [31] SANS 62271-3/ IEC 62271-3 High-voltage switchgear and controlgear — Part 3: Digital interfaces based on IEC 61850
 - [32] 240-42066934 IEC 61850 Protocol implementation document for the purposes of substation automation
 - [33] 240-68235024 Eskom IEC 61850 station bus interoperability test standard
 - [34] 240-89286480, Proposed HV linked isolator (three pole) auxiliary switch (secondary) contact arrangements
 - [35] 240-1489922148, User Specification for online condition monitoring device for air insulated circuit-breakers and isolators/Earthing switches
 - [36] 240-53902499, Standard for the transport, handling, storage and preservation of HV and MV switchgear.
 - [37] TPC41-141: Commissioning of new substation plant documentation and check sheets
 - [38] 0.54/07129: Outdoor application earth switch 220, 275, 400 & 765 kV standard terminal numbering
 - [39] 0.54/07858: Outdoor application isolator 220, 275, 400kV & 765 kV standard terminal numbering
 - [40] 0.54/07861: Outdoor application isolator pantograph 220, 275, 400 & 765 kV standard terminal numbering
 - [41] 0.54/3987: 400 kV three phase bus bar isolator support (5,5 m phase centres)
 - [42] 0.54/3558: 400 kV three phase bus bar earthing switch support tubular substation
 - [43] 240-180000573, Technical Evaluation Criteria for HV AIS - Outdoor Disconnectors and Earthing Switches
 - [44] Annex A – Supplier and Eskom Transmission Responsibilities
 - [45] Annex B – Technical Schedules A & B (Generic typical example)
 - [46] Annex C – Corrosion Protection information
 - [47] Annex D – Drawings – Outline and General Arrangements
 - [48] Annex E – Switchgear Training Requirements from OEM

2.2.2 Informative

- [49] Not Applicable.

2.3 Definitions

2.3.1 General

Definition	Description
Disconnecter	<p>[SANS/IEC 62271-102 subclause 3.4.101]</p> <p>mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements</p> <p>NOTE 1 to entry: A disconnector is capable of opening and closing a circuit when either negligible current is broken or made, or when no significant change in the voltage across the terminals of each of the poles of the disconnector occurs. It is also capable of carrying currents under normal circuit conditions and carrying for a specified time currents under abnormal conditions such as those of short-circuit.</p> <p>NOTE 2 to entry: "Negligible current" implies currents such as the capacitive currents of bushings, busbars, connections, very short lengths of cable, currents of permanently connected grading impedances of circuit-breakers and currents of voltage transformers and dividers (see also IEC/TR 62271-305). For $U_r \leq 420$ kV, a current not exceeding 0,5 A is a negligible current for the purpose of this definition; for $U_r > 420$ kV and currents exceeding 0,5 A, the manufacturer should be consulted. "No significant change in voltage" refers to such applications as the by-passing of induction voltage regulators or circuit-breakers and bus transfer.</p> <p>[SOURCE: IEC 60050-441:2000, 441-14-05, modified – Note 2 to entry has been added]</p>
Disconnecter (Eskom terminology)	it is equivalently used in this Eskom Transmission standard specification for isolators, links, pantograph, semi pantograph and knee type designs.
Earthing Switch	<p>[SANS/IEC 62271-102 subclause 3.4.106]</p> <p>mechanical switching device for earthing parts of a circuit, capable of withstanding for a specified time currents under abnormal conditions such as those of short-circuit, but not required to carry current under normal conditions of the circuit</p> <p>NOTE 1 to entry: An earthing switch may have a short-circuit making capacity.</p> <p>NOTE 2 to entry: An earthing switch of $U_r > 52$ kV may have a rating for switching and carrying induced currents.</p> <p>NOTE 3 to entry: These devices may sometimes be operated against short-circuit. The different classes of earthing switches are related to the number of short-circuit making operations.</p> <p>NOTE 4 to entry: In some cases, earthing switches are used as fault-initiating devices.</p> <p>[SOURCE: IEC 60050-441:2000, 441-14-11, modified – the Notes 2, 3 and 4 to entry have been added]</p>
Outdoor switchgear and controlgear	<p>[IEC 62271-102 subclause 3.1.102]</p> <p>switchgear and controlgear suitable for installation in the open air, i.e. capable of withstanding wind, rain, snow, dirt deposits, condensation, ice and hoar frost</p>
Clearance	<p>[SANS/IEC 62271-102 subclause 3.7.115]</p> <p>distance between two conductive parts along a string stretched the shortest way between these conductive parts</p> <p>[SOURCE: IEC 60050-441:2000, 441-17-31]</p>

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ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**Revision: **1**Page: **9 of 91**

Definition	Description
Contact	[SANS/IEC 62271-102 subclause 3.5.103] <of a mechanical switching device> conductive parts designed to establish circuit continuity when they touch and which, due to their relative motion during an operation, open or close a circuit or, in the case of hinged or sliding contacts, maintain circuit continuity [SOURCE: IEC 60050-441:2000, 441-15-05]
Contact zone	[SANS/IEC 62271-102 subclause 3.5.111] <for divided support disconnectors and earthing switches> spatial region of positions the fixed contact may take up for correct engagement with the moving contact
Main contact	[SANS/IEC 62271-102 subclause 3.5.104] contact included in the main circuit of a mechanical switching device, intended to carry, in the closed position, the current of the main circuit [SOURCE: IEC 60050-441:2000, 441-15-07]
Auxiliary circuit	[SANS/IEC 62271-1 subclause 3.5.4] (of a switching device) all the conductive parts of a switching device which are intended to be included in a circuit other than the main circuit and the control circuits of the device NOTE Some auxiliary circuits fulfil supplementary functions such as signaling, interlocking, etc., and, as such, they may be part of the control circuit of another switching device. [IEV 441-15-04]
Auxiliary switch	[SANS/IEC 62271-1 subclause 3.5.6] (of a mechanical switching device) switch containing one or more control and/or auxiliary contacts mechanically operated by a switching device [IEV 441-15-11]
Auxiliary contact	[SANS/IEC 62271-1 subclause 3.5.8] contact included in an auxiliary circuit and mechanically operated by the switching device [IEV 441-15-10]
In-line arrangement	the individual phases are in parallel with the busbar and in line with each other, with the disconnector in the closed position.
Mechanical terminal load	[SANS/IEC 62271-102 subclause 3.7.119] external load acting on each terminal NOTE 1 to entry: The external load is the result of the combined mechanical forces which may be applied to the terminals of the switching device. Wind forces acting on the equipment itself are not included as they do not contribute to the external load acting on terminals. NOTE 2 to entry: A disconnector or earthing switch can be subjected to several mechanical forces different in value, direction and point of action. NOTE 3 to entry: The terminal loads as defined here do not usually apply to enclosed switchgear.
Bus-transfer current switching	[SANS/IEC 62271-102 subclause 3.7.120] opening and closing of disconnectors under load when this load is not interrupted, but transferred from one bus to a parallel bus

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SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**Revision: **1**Page: **10 of 91**

Definition	Description
Bus-transfer current	[SANS/IEC 62271-102 subclause 3.7.122] current that flows when a load is transferred from one bus system to another
Bus-transfer voltage	[SANS/IEC 62271-102 subclause 3.7.122] power frequency voltage across the open disconnector after breaking or before making the bus-transfer current
Electromagnetically induced current	[SANS/IEC 62271-102 subclause 3.7.124] <on an earthing switch> inductive current that flows through an earthing switch when it connects to and disconnects from earth one termination of a de-energized transmission line, with the other termination earthed, and with an energized line carrying current in parallel with, and in proximity to, the earthed line NOTE 1 to entry: The inductive current in a de-energized line earthed at both terminations is dependent upon the current in the energized line and the coupling factor to the energized line, as determined by the circuit configuration.
Electrostatically induced current	[SANS/IEC 62271-102 subclause 3.7.125] <on an earthing switch> capacitive current that flows through an earthing switch when it connects to and disconnects from earth one termination of a de-energized transmission line, with the other termination open, and with an energized line in parallel with, and in proximity to, the earthed line NOTE 1 to entry: The capacitive current in a de-energized line earthed at one termination is dependent upon the voltage of the energized line, the coupling factor to the energized line as determined by the circuit configuration, and the length of the earthed line between the earthed termination and the open termination.
Bus-charging current switching	[SANS/IEC 62271-102 subclause 3.7.126] making or breaking of bus-charging currents by disconnectors
Bus-charging current	[SANS/IEC 62271-102 subclause 3.7.127] capacitive current that flows when an isolated part of a busbar system is energised or deenergised
Intelligent Electronic Device (IED)	a device incorporating one or more processors with the capability to execute application functions, store data locally in a memory and exchange data with other IEDs (sources or sinks) over a digital link [IEC 61850-5].
Maintenance	[IEC 62271-1 subclause 3.1.6] combination of all technical and administrative actions, including supervision actions, intended to retain an item in, or restore it to, a state in which it can perform a required function [IEV 191-07-01]
Breakdown maintenance	unplanned (or unscheduled) maintenance work required to repair a fault and thus restore the switchgear and controlgear to an acceptable condition after a failure

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Unique Identifier: **240-180000569**

Revision: **1**

Page: **11 of 91**

Definition	Description
Major maintenance (overhaul) (IEC “overhaul” definition with added notes)	<p>[IEC 62271-1 subclause 3.1.11] work performed with the objective of repairing or replacing parts which are found to be out of tolerance by inspection, test, examination, or as required by manufacturer's maintenance manual, in order to restore the component and/or the switchgear and controlgear to an acceptable condition (within tolerance)</p> <p>NOTES: (Eskom Transmission)</p> <ul style="list-style-type: none"> a) The manufacturer's operation and maintenance instruction manual are also accompanied by Eskom Transmission standards b) Major maintenance involves the execution of specialised maintenance where specialised knowledge and skills are required and is also sometimes referred to as specialised maintenance or corrective maintenance.
Minor maintenance (Preventative Maintenance and Tests)	<p>the execution of scheduled or preventive maintenance work in accordance with the manufacturer's operation and maintenance instruction manual and Eskom Transmission standards, requiring the switchgear and controlgear to be taken out of service (i.e. in a down state).</p> <p>NOTES:</p> <ul style="list-style-type: none"> a) Observations resulting from minor maintenance can lead to the decision to carry out an overhaul. b) Scheduled maintenance is defined in 3.1.7 of SANS 62271-1. c) Minor maintenance may be time-based and/or condition-based. d) Minor maintenance may also include disconnector and earthing switch examination (refer to 3.1.10 of SANS 62271-1) with diagnostic tests (refer to 3.1.9 of SANS 62271-1). <p>Minor maintenance may also be referred to as Intrusive Maintenance or Corrective Maintenance</p>
Routine inspection (IEC “Inspection” definition with added notes)	<p>[IEC 62271-1 subclause 3.1.8] visual investigation of the principal features of the switchgear and controlgear in service without dismantling</p> <p>NOTE 1 This inspection is generally directed toward pressures and/or levels of fluids, tightness, position of relays, pollution of insulating parts, but actions such as lubricating, cleaning, washing, etc. which can be carried out with the switchgear and controlgear in service are also included.</p> <p>NOTE 2 Observations resulting from inspection can lead to the decision to carry out overhaul.</p> <p>NOTES: (Eskom Transmission)</p> <ul style="list-style-type: none"> a) As indicated in NOTE 1 above, routine inspection may include scheduled maintenance activities in accordance with the manufacturer's operation and maintenance instruction manual and Eskom Transmission standards. b) Routine inspection may also be referred to as 1st line maintenance.
Specialised tools	any purpose-built tools that are necessary to carry out major (or specialised) maintenance on a disconnector or earthing switch and its components
Submission	the tender in accordance with the requirements of the enquiry
Working clearance	straight line distance (clearance) from the closest live part at service voltage to ground level required to safely conduct work.

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2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
AM SED	Asset Management, Substation Equipment and Diagnostics
AMSL	Above mean sea level
Class M1 (Mechanical endurance)	Disconnecter having an extended mechanical endurance of 2 000 operating cycles
Class M2 (Mechanical endurance)	Disconnecter having an extended mechanical endurance of 10 000 operating cycles
Eskom	Eskom Holdings SOC (Ltd)
FACTS	Flexible A.C. Transmission Systems
FMECA	Failure Modes, Effects and Criticality Analysis
GIS	Gas Insulated Switchgear
HVDC	High Voltage Direct Current
IED	Intelligent Electronic Device
MCB	Miniature circuit-breaker
MTS	Mixed Technology Switchgear
NRS	National Rationalised Standard
OEM	Original equipment manufacturer
ORHVS	Operating Regulations for High Voltage Systems
PMT	Preventative Maintenance and Tests
PTM&C	Protection Telecoms Metering and Control
PVC	Poly Vinyl Chloride
RIV	Radio Interference Voltage
SANS	South African National Standards
SCD	Specific creepage distance
SPS class	Site Pollution Severity class
Tx	Transmission
USB	Universal Serial Bus
USCD	Unified specific creepage distance

2.5 Roles and responsibilities

Tx AM SED – shall ensure that the approved standard specification is in place for use by Eskom Transmission.

Commercial Management – Make use of the up to date version of this document during procurement processes.

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Project Management – Make use of the up to date version of this document during procurement processes and all stages of projects or asset creation.

Grids, Asset Management, Quality Management and Warehouse Management (Logistics) – Make reference to this document and the technical standard specification during switchgear asset entering service and its entire minimum service life expectancy as specified by Eskom Transmission.

Technical evaluator – Implement the contents of this document applicable to equipment covered by its scope. Technical evaluation report shall be compiled for Eskom Transmission purposes that indicates and refers to the clauses of this document.

The Supplier shall respond with the technical submission that meets the requirements of this technical standard specification, provide the required documentation, and ensure the compliance to the detailed list of Supplier and Eskom Transmission responsibilities are covered under Annex A.

2.6 Process for monitoring

None.

2.7 Related/supporting documents

Related Documents:

Technical A & B schedules.

This standard specification supersedes these documents in Eskom Transmission:

240-56063815 Rev 3, High Voltage Disconnectors and Earthing Switches Standard

240-124520996 Rev 1, Switchgear training requirements from original equipment manufacturers

240-56065202 Rev 1, Distribution Standard Part 7: Switchgear training requirements from original equipment manufacturers

240-46425564 Rev 7, Technical evaluation criteria for High Voltage Switchgear standard

3. Specification for High Voltage Air Insulated Switchgear rated for Voltages 1 kV and above – Outdoor Disconnectors and Earthing Switches

Below are the detailed contents of the Eskom Transmission Specification for High Voltage Air Insulated Switchgear rated for Voltages 1 kV and above – Outdoor Disconnectors and Earthing Switches.

3.1 Ratings

Below are standard Eskom Transmission ratings required to be met for disconnectors and earthing switches for this standard specification.

All required ratings are specified in schedule A. The ratings stated in Schedule B shall be the actual values determined by type testing, not merely the values specified in schedule A.

3.1.1 Rated voltage (U_r) and number of phases

- a) The rated voltage of disconnectors and earthing switches shall be in accordance with the values given in Table 1. The rated voltage required will be specified in Schedule A. The rated voltage offered shall be stated in Schedule B.

NOTE: The nominal system voltages (U_n) in Eskom Transmission are 6,6 kV, 11 kV, 22 kV, 33 kV, 44 kV, 66 kV, 88 kV, 132 kV, 220 kV, 275 kV, 400 kV and 765 kV. it shall be noted that the specific disconnectors and earthing switches ratings are use as follows. the specified rating of:-

- 275 kV is used on both the 275 kV system and 220 kV system;

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SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED SWITCHGEAR RATED FOR VOLTAGES 1 KV AND ABOVE – OUTDOOR DISCONNECTORS AND EARTHING SWITCHES
Unique Identifier: **240-180000569**Revision: **1**Page: **14 of 91**

- 132 kV is used on the 132 kV system, 110 kV application and 88 kV system;
- 66 kV is used on the 66 kV system, 50 kV traction applications and 44 kV system;
- 33 kV is used on 33 kV system and reactive power compensations FACTS applications (30 kV and 15 kV).
- 22 kV is used on 22 kV system, 11 kV system and below;

b) The number of phases shall be three.

NOTE: Only upon special applications, e.g. traction application, reactive power compensation FACTS, HVDC converter substation, shall a Technical A/ B Schedule of less than 3-phase be issued for Supplier to respond accordingly on the Schedule B.

3.1.2 Rated insulation levels

The rated insulation levels of disconnectors and earthing switches shall be in accordance with the values given in Table 1. The rated insulation levels offered shall be stated in Schedule B. No additional altitude correction factors need be applied for equipment installed up to 1800 m AMSL.

Table 1: Rated voltage and insulation levels

Nominal system voltage U_n [kV (r.m.s.)]	Rated voltage [kV (r.m.s.)]	Rated short-duration power-frequency withstand voltage U_d [kV (r.m.s.)] U_r		Rated lightning impulse withstand voltage U_p [kV (peak)]		Rated switching impulse withstand voltage U_s [kV (peak)]		
		Phase-to-earth and between phases	Across open switching device	Phase-to-earth and between phases	Across open switching device	Phase-to-earth and across open switching device	Between phases	Across isolating distance
6,6 & 11	12 ^{e)}	28	32	75	85	N/A	N/A	N/A
22	24 ^{e)}	50	60	125	145	N/A	N/A	N/A
33	36 ^{e)}	70	80	170	195	N/A	N/A	N/A
44	52 ^{e)}	95	110	250	290	N/A	N/A	N/A
66	72,5 ^{e,g)}	140	160	325	375	N/A	N/A	N/A
88	100 ^{e,g)}	185	210	450	520	N/A	N/A	N/A
132	145 ^{e,g)}	230 275	265 315	550 650	630 750	N/A	N/A	N/A
220	245 ^{e)}	395	460	950	1 050	N/A	N/A	N/A
275	300 ^{e)}	395	435	1 050	1 050+(170)	850	1 275	700 + (245)
275	300 ^{e,f)}	395	435	1 175	1 175(+205)	850	1 275	800(+295)
400	420 ⁱ⁾	520	610	1 425	1 425 (+240)	1 050	1 575	900(+345)
400	420 ^{h)}	520	610	1 550	1 550 (+315)	1 175	1 680	900(+450)
765	800 ⁱ⁾	830	1150	2 100	2 100 (+455)	1 550	2 480	1 175(+650)
+/- 533 DC	i)							

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**Revision: **1**Page: **15 of 91****NOTES:**

- a) In this table, the withstand voltages apply at the standardised reference atmosphere (temperature, pressure and humidity) in accordance with SANS 62271-1 subclause 5.3.
- b) The information in this table is based on SANS 1019 and SANS 62271-1.
- c) The specification of the insulation levels given in this table is based on the SANS 1019 philosophy – i.e. by the judicious selection of protective devices and their location with respect to equipment to be protected, it is generally possible to adopt the same insulation level for internal insulation and external insulation for equipment suitable for use at altitudes up to 1 800 m AMSL (Above Mean Sea Level). This enables manufacturers and users (Eskom Transmission) to adopt internationally accepted designs for use in South Africa.
- d) No additional altitude correction factors need be applied for equipment installed up to 1800 m AMSL.
- e) For the purposes of Eskom Transmission standardisation of HV switchgear, the specified - 22 kV disconnectors and earthing switches shall be installed on 22 kV and below, including 15 kV reactive power compensation FACTS applications; - the 33 kV used on 33 kV network and 30 kV FACTS application; - the 66 kV used on 66 kV network and 50 kV traction application, the 132 kV used on 132 kV, 110 kV and 88 kV networks, the 275 kV used on 275 kV and 220 kV networks.
- f) The Eskom Transmission 275 kV requirement - the disconnectors and earthing switches with insulation level of rated lightning impulse withstand voltage (BIL) of 1175 kV are also applied.
- g) Where substation design has space constraints, the vertical isolation is a solution for the Eskom Transmission substation on the 132 kV and 88 kV networks, the 132 kV pantograph disconnectors are used. The 66 kV and below networks designs optimise on horizontal isolation using the conventional disconnectors. Pantograph disconnectors are applied by Eskom Transmission for all substation vertical clearance requirements from 88 kV up to 550 kV switchyards.
- h) The Eskom Transmission 400 kV requirement - the disconnectors and earthing switches with insulation level of rated lightning impulse withstand voltage (BIL) of 1550 kV are also applied.
- i) The Eskom Transmission disconnectors specified for use on the 765 kV network are knee-type design.
- j) The disconnectors and earthing switches specified for DC application shall be installed on Eskom Transmission's +/- 533kV HVDC network upon special requirements. The voltage across open contacts is 133.3 kV DC rating. The DC voltage rating from ground (earth) for HVDC Pole Selection No 1 and No 2 is 133.3 kV DC and for the Bypass Bridges is – 133.3 kV for Bridges No 1 and No 2; 267 kV DC for Bridges No 3 and No 4; 400 kV DC for Bridges No 5 and No 6; and 533 kV for Bridges No 7 and No 8.
- k) For the purposes of Eskom Transmission standardisation and interchangeability, the bus transfer switching devices (BTSD) are standard requirement on all disconnectors.
- l) For the purposes of Eskom Transmission standardisation and interchangeability, the induced current switching devices (ICSD) are standard requirement on all earthing switches that are to be on the line side of the feeder application.
- m) The replacement of 275 kV inline side-break isolators at Apollo Converter Substation shall be specified accordingly on its Technical Schedule A.
- n) Traction requirements shall be specified on Technical Schedule A – where disconnectors of less than 3-poles are required

3.1.3 Rated frequency (f_r)

The rated frequency shall be 50 Hz.

NOTE: This is not applicable for the HVDC converter substation requirement. Also for traction application, the system frequency may differ.

3.1.4 Rated continuous (normal) current (I_r) and temperature rise

The rated normal current (i.e. continuous current) is the maximum current the switch shall be required to carry continuously under usual service conditions without exceeding specified temperature limits.

- a) The rated normal current of disconnectors shall be 1600 A, 2500 A, 3150 A and 4000 A, and the SANS/ IEC 62271-1 subclause 5.5 shall be applicable. For HVDC converter substation, the rated current of disconnectors is 1800 A DC.

The rated normal current required will be specified in Schedule A. The rated continuous (normal) current offered shall be stated in Schedule B.

- b) The standard rated normal currents of disconnectors are given in **Table 2**.

Table 2: Standardised rated normal currents (I_r)

Nominal system voltage U_n [kV]	Rated normal current (I_r) [A]
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SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED SWITCHGEAR RATED FOR VOLTAGES 1 KV AND ABOVE – OUTDOOR DISCONNECTORS AND EARTHING SWITCHES

Unique Identifier: **240-180000569**Revision: **1**Page: **16 of 91**

	1600	2500	3150	4000	1800 DC
22 (also used on 11)	x ^{a)}	x	-	-	-
33 (also used on 22 & 11)	-	x ^{b)}	-	-	-
66 (also used on 44)	-	x	x ^{c)}	-	-
132 (also used on 88)	-	x	x	-	-
275 (also used on 220)	-	-	x	-	-
400	-	-	x	x	-
400 (550 used on 400)	-	-		x ^{d)}	-
765	-	-	x	x	-
+/- 533 DC (Across open contacts withstand: 133.3 DC)	-	-	-	-	x ^{e)}

NOTES:

- The 22 kV disconnectors rated for 1600 A shall be applied by Eskom Transmission substation applications with low MVA continuous loading especially when transformation is less than 500 MVA.
- The 33 kV disconnectors with motor operations, shall be applied by Eskom Transmission at the reactive power compensation FACTS application, demarcated as live yards.
- The 66 kV disconnectors rated for 3150 A shall be applied where disconnectors of the same current rating are required by Eskom Transmission e.g. at busbars of reactive power compensation FACTS devices.
- The 550 kV disconnectors shall be applied by Eskom Transmission at special requirements where insulation requirements are not met by the standard 400 kV disconnectors.
- For Eskom Transmission's +/- 533 kV HVDC system requirement, the rated normal current shall be 1800A DC as a minimum. It shall be demonstrated if the disconnector can carry the current of 3300A upon emergency or future requirements.

- The associated temperature rise limits for the rated normal current given in **Table 2** shall be in accordance with SANS 62271-1 subclause 7.5.6 Table 14.
- Based on the actual results of the disconnector continuous current (temperature rise) type testing, in accordance with SATR 62271-306, the calculated maximum continuous current that the disconnector can carry, without exceeding the maximum allowable temperatures for the major components, shall be stated in Schedule B for a maximum ambient temperature of i) 40 °C and ii) 45 °C (refer to subclause 3.2.2 a), also subclause 3.3.2.1.3)
- Based on the actual results of the disconnector continuous current (temperature rise) type testing, in accordance with SATR 62271-306, the highest measured temperature rise values for the major components (refer to SANS 62271-1 subclause 7.5.6 Table 14) when carrying rated current shall be stated in Schedule B. (Also refer to subclause 3.3.2.1.3)

3.1.5 Rated short-time withstand current (k)

The rated short-time withstand current of disconnectors and earthing switches shall be in accordance with subclause 5.6 of the SANS 62271-1 standard, with the Eskom Transmission requirement values given in Standardised rated short circuit-breaking, short-time and peak withstand currents.

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**
Unique Identifier: **240-180000569**Revision: **1**Page: **17 of 91**

If an earthing switch is combined with a disconnecter as a single unit (disconnecter with its integral earthing switch), the rated short-time withstand current of the earthing switch shall, unless otherwise specified, be at least equal to that assigned to the disconnecter.

The rated short-time withstand current required will be specified in Schedule A. The rated short-time withstand current offered shall be stated in Schedule B.

3.1.6 Rated peak withstand current (I_p)

The rated peak withstand current of disconnectors and earthing switches shall be in accordance with subclause 5.7 of the SANS 62271-1 standard, with the Eskom Transmission requirement values given in **Table 3**.

If an earthing switch is combined with a disconnecter as a single unit (disconnecter with its integral earthing switch), the rated peak withstand current of the earthing switch shall, unless otherwise specified, be at least equal to that assigned to the disconnecter.

The rated peak withstand current required will be specified in Schedule A. The rated peak withstand current offered shall be stated in Schedule B.

3.1.7 Rated duration of short-circuit (t_k)

The rated duration of the short-circuit (t_k) shall be 3 seconds, in accordance with subclause 5.8 of SANS 62271-1.

If an earthing switch is combined with a disconnecter as a single unit (disconnecter with its integral earthing switch), the rated duration of the short-time withstand current of the earthing switch shall, unless otherwise specified, be at least equal to that assigned to the disconnecter.

Table 3: Standardised rated short circuit-breaking, short-time and peak withstand currents

Nominal system voltage U_n [kV]	Rated short-circuit breaking and short-time (3 sec) withstand current I_{sc} , kA [kA (r. m. s.)]	Rated peak withstand current I_p [kA (peak)]
22 (also used on 11)	25	62,5
22 (also used on 11)	31,5	78,75
33 (also used on 22 & 11)	31,5	78,75
66 (also used on 44)	31,5	78,75
132 (also used on 88)	40	100
275 (also used on 220)	50	125
400*)	50 / 63	125 / 157,5
400 (550 used on 400)	63	157,5
765	50	125
+/- 533 DC **)	20	50

SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED SWITCHGEAR RATED FOR VOLTAGES 1 KV AND ABOVE – OUTDOOR DISCONNECTORS AND EARTHING SWITCHES

Unique Identifier: **240-180000569**

Revision: **1**

Page: **18 of 91**

NOTES:

- a) The 22 kV disconnectors rated for 31,5 kA shall be applied by Eskom Transmission substation applications also to 11 kV network.
- b) The 33 kV disconnectors with motor operations, shall be applied by Eskom Transmission at the reactive power compensation FACTS application, demarcated as live-chamber yards.
- c) The disconnectors rated for 3150 A shall be applied only where circuit-breakers of the same current rating are required by Eskom Transmission e.g. at busbars of reactive power compensation FACTS devices.
- d) The 550 kV disconnectors shall be applied by Eskom Transmission at special requirements where insulation requirements are not met by the standard 400 kV disconnectors.
- e) For Eskom Transmission's +/- 533kV HVDC system requirement, the rated normal current shall be 1800 A DC as a minimum. It shall be demonstrated if the disconnectors can carry the current of 3300 A upon emergency or future requirements.

*) - denotes that both 420 kV and 550 kV rated disconnectors and earthing switches are required to meet this criteria

**) - denotes that the +/- 533 kV DC rated disconnectors and earthing switches are required to meet this minimum criteria.

The voltage across open gap is 133.3 kV DC

3.1.8 Rated supply voltage of closing and opening devices and of auxiliary and control circuits (U_a)

- a) The rated d.c. supply voltage (U_a) of closing and opening devices and of auxiliary and control circuits shall be in accordance with SANS 62271-1 subclause 5.9, specified as 110 V or 220 V. The rated d.c. supply voltage required will be specified in schedule A.
- b) The rated a.c. supply voltage (U_a) of heaters and other a.c. auxiliary circuits shall be single-phase 230 V.

3.1.8.1 Rated supply frequency of closing and opening devices and of auxiliary circuits

The rated supply frequency of heaters and other a.c. auxiliary circuits shall be 50 Hz, as per SANS 62271-1 subclause 5.10.

3.1.9 Rated short-circuit making current (I_{ma}) of the Earthing Switch

The earthing switches specified to have rated short-circuit making current shall be in accordance with SANS 62271-102 subclause 5.101 and its Table 1, also taking note of subclause 9.2.110 that short-circuit making capability is not expected for outdoor AIS earthing switches of ratings below 52 kV (i.e. 44 kV downwards). The Supplier and its manufacturer shall indicate the rating and the applicable classification of the earthing switch design in the tender documentation as follow:-

- E0 = Earthing switch with no short-circuit making capability
- E1 = Earthing switch with capability to perform two short-circuit making operations
- E2 = Earthing switch with capability to perform five short-circuit making operations

For earthing switches within the gas insulated switchgear (GIS) or compact Mixed Technology Switchgear (MTS) also known as Hybrid Switchgear the short-circuit-making capability higher than E0 is the Eskom requirement.

NOTE: Eskom Transmission preference for earthing switches on GIS or compact MTS (hybrid designs) rated making current is the classification of E1 (as a minimum). When the earthing switch is designed to mitigate switching transients by very fast closing (very fast acting) on the faulted circuit, the preference shall be classification E2

If an earthing switch has a rated short-circuit making current, this shall be equal to the rated peak withstand current. The short-circuit making capability of earthing switch to perform a defined number of under short-circuit making operations, without major maintenance, shall correspond to SANS 62271-102 subclause 5.101 and 5.102, one of the classes given Table 1.

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The rated short-circuit making current shall be specified in schedule A. The Supplier shall state the rated short-circuit making current offered in schedule B.

3.1.10 Rated contact zone

The divided support disconnectors and earthing switches, namely Eskom Transmission requirement for pantographs, (vertical) knee-type design and upon special requirement the earthing switches, shall have rated values of contact zone from their manufacturer in accordance with SANS 62271-102 subclause 5.103, and its preferred values on Table 2 (supported by flexible conductors) and Table 3 (supported by rigid conductors). The Supplier shall submit the rated contact zone with tender documentation.

This refers also to a tolerable angular displacement of the fixed contact. For proper function of the disconnector or earthing switch, Eskom Transmission designs shall ensure that the fixed contact stays within these limits by considering the service conditions of specified substation design and the cantilever strength of insulators. It represents the most unfavourable condition with respect to the mounting of the fixed contact to flexible conductors or a rigid conductor.

3.1.11 Rated Mechanical Terminal Load

The rated mechanical terminal load shall be stated by the manufacturer in accordance with SANS 62271-102 subclause 5.104.

Disconnectors and earthing switches shall be able to close and open while subjected to their rated static mechanical terminal loads.

The maximum static mechanical terminal load (SMTL) to which the terminal of a disconnector or earthing switch is allowed to be subjected under the most disadvantageous conditions is the rated static mechanical terminal load of this disconnector. The preferred rated static mechanical terminal loads guide given in Table 4 of SANS 62271-102 shall be applicable. The Supplier shall state the rated mechanical terminal load and maximum static mechanical load (SMTL) in the schedule B.

3.1.12 Classification of Mechanical Endurance of the disconnector

The mechanical endurance of the disconnectors shall be classified in accordance with SANS 62271-102 subclause 5.105 and its Table 5. The disconnector shall be able to perform the assigned number of operations taking into account the programme of maintenance specified by the manufacturer. Eskom Transmission shall specify the required mechanical endurance class of the disconnector in schedule A, as per **Table 4**.

The Supplier shall state the mechanical endurance class of the disconnector in schedule B.

Table 4: Classification of disconnectors for mechanical endurance

Class	Number of operating cycles	Mechanical Endurance
M0	1 000	Normal
M1	2 000	Extended
M2	10 000	Extended

3.1.13 Classification of Mechanical Endurance of the earthing switches

The mechanical endurance of the earthing switches shall be classified in accordance with SANS 62271-102 subclause 5.106 and its Table 6. The earthing switch shall be able to perform the assigned number of operations taking into account the programme of maintenance specified by the manufacturer. Eskom Transmission shall specify the required mechanical endurance class of the earthing switch in schedule A, as per **Table 5**.

The Supplier shall state the mechanical endurance class of the earthing switch in schedule B.

Table 5: Classification of earthing switches for mechanical endurance

Class	Number of operating cycles	Mechanical Endurance
M0	1 000	Normal
M1	2 000	Extended

3.1.14 Rated ice-coating

The rated ice-coating shall be stated in schedule B.

Notwithstanding the fact that the operating environment at some locations is occasionally experiencing very cold winters due to the increasing weather changing patterns, the mechanical strength reserves and safety operating factors of the equipment shall be demonstrated by having successfully passed an ice-coating test according to SANS 62271-102 subclause 5.107 of 1 mm thickness (applicable to substations in areas not recorded icing conditions) and 10 mm thickness (applicable to substations in areas recording icing conditions).

3.1.15 Rated values of disconnectors for bus-transfer current switching

3.1.15.1 Rated bus-transfer current

This section is applicable to disconnectors rated 52 kV and above. The Supplier shall state the rated value of bus transfer current switching capability in schedule B.

The value of the rated bus-transfer current for both air-insulated and gas-insulated disconnectors shall be in accordance with SANS 62271-102 subclause 108, specified as follows:-

- for 66 kV up to just below rated voltage of 245 kV:
80 % of the rated continuous current of the disconnector, but limited to 1 600 A;
- for 220 kV up to just below rated voltage of 550 kV:
60 % of the rated continuous current of the disconnector, but limited to 4 000 A;
- for rated voltages of 550 kV and above (765 kV system voltage):
80 % of the rated continuous current of the disconnector, but limited to 4 000 A.

NOTE: The Supplier shall refer to SANS 62271-102 subclause 5.108 NOTE 1 and NOTE 2.

3.1.15.2 Rated bus-transfer voltage

The rated bus-transfer voltages of air-insulated and gas-insulated disconnectors shall be in accordance with Table 7 of SANS 62271-102 subclause 5.108, in alignment to the three voltage ratings categories listed under subclause 3.1.15.1 above. Different bus-transfer voltages than the values given in Table 7 below may be assigned by the manufacturer.

3.1.16 Classification and rated values of earthing switches Induced current switching

Rated induced current and voltage shall be in accordance with SANS 62271-102 subclause 5.109 and its Table 8. The manufacturer shall assign this rating to earthing switches of $U_r > 52$ kV and designed for making or breaking of inductive or capacitive induced currents (refer to definitions 3.7.124 and 3.7.125), hence requiring an induced current switching capability.

For this application, a classification for induced current switching (class A or B) shall be assigned to the earthing switch. This class depends upon the severity of the induced current switching duty. The classification of earthing switches for induced current switching shall be in accordance with Table 8 of SANS 62271-102 subclause 5.109. The Supplier shall state the rated value of the induced current switching capability in schedule B.

The rated values of induced currents and voltages for the earthing switches shall be in accordance with Table 9 of SANS 62271-102 subclause 5.109. The Supplier shall state the rated value of the induced current and voltages in schedule B.

3.1.17 Classification and rated values of disconnectors for bus-charging current switching

The Eskom Transmission disconnectors forming part of the gas-insulated switchgear (GIS) or compact Mixed Technology Switchgear (MTS) also known as Hybrid Switchgear, of rated voltages of 300 kV (system voltage 275 kV) and above shall be classified for bus-charging current switching performance in accordance with SANS 62271-102 subclause 5.110 and its Table 10 for the classification and Test Duties and the Table 11 for the rated bus-charging currents. The Supplier shall submit records of the tests performed by the manufacturer to fulfil the rating in accordance with SANS 62271-102 subclause 5.110. The Supplier shall state the classification and rated bus bus-charging current switching capability in schedule B.

NOTE: s per NOTE on SANS 62271-102 subclause 110: Bus-charging switching capability for air-insulated disconnectors is subject to agreement between the manufacturer and the user (Eskom Transmission), refer to IEC/TR 62271-305.

3.2 Design and construction

3.2.1 Design, Component and Material Changes

- a) Design life expectancy of the equipment shall be to the type tested values of the design, mechanical and electrical endurance but is expected to be not less than 40 years when operating at least twice per day.
- b) Within normal operating specified in this standard specification, the Eskom Transmission approved equipment, its design and construction, shall require normal maintenance as stated by the OEM's instruction operating maintenance manuals, without any requirement for changes or modification.
 - i. During the period covered by a particular contract or product acceptance cycle, the Supplier shall not make any changes to the equipment or materials without receiving approval from Eskom Transmission. All concessions shall be approved by Eskom Transmission. No changes will be permitted to the mounting details of the equipment or in other points of interfacing with Eskom Transmission standard structures. If the Supplier decides to make any changes to the agreed-upon design of the disconnector or earthing switch, then the change(s) (a modification instruction with pictures, drawings and measurements), together with the reasons for making the change(s), shall be forwarded to the Eskom Transmission contract manager and relevant technical switchgear specialists in writing for assessment if approval can be considered (refer to subclause 3.5.5 and Eskom Transmission Quality documentation).
 - ii. Suitable training and parts shall be supplied to Eskom Transmission within 90 days up to 6 months of any modification required for all disconnectors and earthing switches supplied to Eskom.

3.2.2 Service conditions

- a) The normal service conditions for outdoor switchgear and controlgear specified in SANS 62271-102 and SANS 62271-1 subclause 2.1.2 shall apply, and the disconnectors and earthing switches shall have been tested in accordance with applicable subclauses. The following additional specific requirements shall be taken into account:
 - iii. a minimum ambient air temperature of -10 °C; and a maximum ambient air temperature of +45 °C (refer to subclause 3.1.4 g)). Rapid temperature changes shall be taken into account. The condensation of water vapour can take place within operating mechanism enclosures and hollow components. The average humidity is 95 %. The disconnector and earthing switch shall have been type tested in accordance with SANS 62271-102 subclause 7.104;
 - iv. wind velocity of 34 m/s (N) i.e. 700 Pa;
 - v. solar radiation up to a level of 1 100 W/m² (on a clear day at noon) as well as significant ultra-violet (UV) radiation intensity;

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- vi. the disconnectors and earthing switches shall be installed up to altitudes of 1 800 m. De-rating effects due to lower air density in terms of dielectric withstand, Radio Interference Voltage (RIV) behaviour and continuous current handling capability up to an altitude of 1 800 m above sea level shall be taken into design consideration by the manufacturer;

NOTE: Due (in part) to the fact that the switchgear and controlgear shall be used up to altitudes of 1800 m AMSL (Above Mean Sea Level), altitude-corrected insulation withstand levels are specified in this document. No further altitude correction factors are therefore required for altitudes above 1000 m AMSL in accordance with SANS 62271-1.

- vii. Airborne pollution in the form of dust, smoke, corrosive gases and saline content due to location in areas of industrial activity, close proximity to the sea and so on. The class of pollution characterising the site severity will be specified in Schedule A in accordance with SANS 60815-1:2009 (e.g. class "e" corresponding to "very heavy"); and
- The class of corrosion characterizing the site severity will be specified in Schedule A in accordance and the details required under subclause 3.2.14 shall be supplied with tender documentation.
- viii. seismic activity up to 0,3g. Unusual service conditions, such as abnormal vibration, shocks, tremors, and/or tilting
- ix. Mechanical forces in accordance with SANS/IEC 62271-102 in any direction imposed on the main terminals e.g. overhead conductor loadings (temperature fluctuations), pollution deposits and occasional icing deposits or snow upon severe cold winters;

- b) Disconnectors and earthing switches for use in systems of nominal voltage up to and including 132 kV shall be suitable for operation in systems that incorporate a non-effectively earthed neutral. Disconnectors and earthing switches for use in systems of nominal voltage above 132 kV shall be suitable for operation in systems that incorporate an effectively earthed neutral.

NOTE: 44 kV to 132 kV networks are usually effectively earthed. However, certain 44 kV to 132 kV networks may be non-effectively earthed.

3.2.3 General

NOTE: Notwithstanding the requirements on 3.2.2.1 below, the Supplier of the switchgear shall respond to the following with the tender documentation:-

- Provide the detailed Factory Failure Rate (FFR) percentage over the period of 5 years.
- Provide information on On Time Delivery (OTD) percentage over the period of 5 years.
- Provide technical response to Non-Conformance (NCR's) percentage over a period of 1 year

3.2.3.1 The following are the requirements for the disconnectors and earthing switches:-

- a) Outdoor disconnectors and earthing switches shall comply with the requirements of SANS 62271-102 and the requirements of this standard specification. In case of the gas insulated switchgear (GIS) or compact Mixed Technology Switchgear (MTS) also known as Hybrid Switchgear, it shall also comply with the requirements of SANS 62271-203. Where conflicting requirements exist, the requirements of this standard specification shall take precedence.
- b) Disconnectors shall be of the manual hand operation or motor operation. Where motor operation is specified, the manual hand operation facility shall be provided. For voltages of 220 kV and above, the disconnectors shall be specified as motor operated as a standard. The type of design required will be specified in Schedule A. The type of design offered shall be stated in Schedule B.

- c) Earthing switches shall be of the manual hand operation as a standard. Only where the physical design dimension might be demanding the motor operation as part of the manufacturer design, this shall be limited to the local on the mechanism panel operation (not for remote operation) in-order to assist the dispatched operating personnel duty. For voltages of 765 kV, this shall be assessed by Eskom Transmission if the design will not pose conflict with the protection and control scheme operation of the earthing switch. Approval shall be considered only if the manufacturer has demonstrated that there are no possibilities of this operation conflict. The type of design required will be specified in Schedule A. The type of design offered shall be stated in Schedule B.
- d) Disconnecter and earthing switch shall be supplied complete with all the necessary components for the assembly. Disconnectors and earthing switches for use in systems of nominal voltage up to and including 550 kV shall be designed to fit on the Eskom standard interface steel support structures. For disconnectors with rated voltages of 765 kV it shall be specified in Schedule A whether disconnectors shall be supplied with the manufacturer designed steel support structure or Eskom standard interface steel support structure.

NOTE - For further information relating to the Supplier's and Eskom Transmission's scope of responsibility (refer to Annex A)

- e) Disconnectors and earthing switches shall be designed for minimal maintenance in accordance with the electrical and mechanical endurance class as specified herein this standard specification. The minimum expected lifespan shall be 40 years. Premature failures experienced in service of similar design disconnector and earthing switch supplied elsewhere by the manufacturer shall be made known to Eskom Transmission, together with the recommended modifications. This information shall be provided with the tender documentation (refer to subclause 3.2.26.1).

3.2.4 Construction requirements

The design and layout of the disconnector and earthing switch, including control cable interfacing, shall facilitate installation with a minimum of on-site assembly work. The degree of assembly work in the factory shall be optimised such that on-site installation work is minimised. The following principles shall apply to the design of the equipment:

- a) the various elements of the disconnector and earthing switch shall be standardised. Standardisation of parts shall be pursued;
- b) modular, pre-assembled elements shall be designed to facilitate handling and installation;
- c) the equipment shall be designed to facilitate construction and maintenance activities for personnel; and
- d) Special operating tools housing shall be located (at the disconnector pole and earthing switch pole) in such a manner so as to provide easy access when maintaining the unit.

3.2.5 Type of disconnector

The type of disconnector, e.g. conventional, pantograph or knee-type, shall be as specified in schedule A. The Supplier shall state the type of disconnector in schedule B.

NOTE: Only the exact type of disconnector specified will be acceptable. No alternatives will be considered.

Type of Operation for the Disconnector

- a) Hand operated mechanism shall be for voltages up to 132 kV with the option of motor operated for 66 kV up to 132 kV.
- b) For voltages 220 kV and above shall only be motor operated. The type of operation as well as the number of operating mechanisms per disconnector shall be as specified in schedule A. The Supplier shall state the disconnector type of operation in schedule B.
- c) For voltages above 132 kV, only double action low friction entry current path disconnector shall be acceptable.
- d) For 132 kV and below voltages, the low friction entry is preferred but also proven direct free entry designs shall be considered.

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- e) All disconnectors shall have type tested and proven dead centre or over-locking method.

3.2.6 Earthing switch

3.2.6.1 Type of the earthing switch

The number and type of earthing switch namely in-built or separate free standing shall be as specified in schedule A. The Supplier shall state the type of offered earthing switch in schedule B.

NOTE: An in-built earthing switch means an earthing switch fitted to a disconnector using portions of the disconnector for its construction. This is also referred to as the integral earthing switch.

3.2.6.2 Type of operation

The type of operation for earthing switches shall be specified in schedule A. unless otherwise specified; three-pole ganged manual operation is standard. The Supplier shall state the type of offered earthing switch operation in schedule B. From rated voltages at and above 220 kV, only double-action motion of the earthing switch blade shall be acceptable.

3.2.6.3 Special requirement of the earthing switches

The SANS 62271-102 subclauses 6.3 and 6.101 shall be applicable with the following additions:-

Flexible copper connections between movable parts of an earthing switch and its frame shall have a cross section of at least 50 mm².

This minimum value of the cross-sectional area of copper connections is given to ensure mechanical strength and resistance to corrosion.

Where the flexible connection is used to carry the short-circuit current, it shall be designed accordingly. If another material is used, a suitable equivalent of cross-section shall be provided.

3.2.7 Mechanical and physical features

3.2.7.1 Base Frames

- a) Base frames of equipment shall be fixed to the support structure in such a manner as to avoid distortion or excessive deflection when in operation.
- b) Base frames shall not permit bird nesting. The accessibility of birds into mechanical parts of the disconnector will be assessed by Eskom and be modified at no cost if required.

3.2.7.2 Bearings

- a) Base bearings and bearings requiring protection from the elements shall be of the sealed type.
- b) Bearing housings shall not permit internal condensation and accumulation of moisture.
- c) Bearings shall be appropriate for the application i.e. high thrust and cantilever loads. Due cognisance must be taken of vibrations set up in service which can influence performance of such bearings.
- d) Bearings shall be of a standard commercially available type and available from various manufacturers and local agencies.

3.2.7.3 Bushes

- a) The information about the type of bushes used and method of lubrication shall be provided with tender documents.
- b) Where bushes are provided requiring periodic lubrication, standard type grease nipples shall be provided.
- c) Bushes claimed to require no periodic lubrication must have a proven track record.

3.2.7.4 Gears

- a) Any gearing arrangements used on the operating mechanism shall be adequately covered and protected against environmental elements.
- b) Any interlocking arrangements that are enclosed shall be protected to a rating of IP2X.

3.2.7.5 Linkages

- a) Inter-phase linkages and other motion transfer arrangements shall transmit the operating forces in an efficient and stress-free manner.
- b) Self-aligning features shall be provided at the ends of linkages to accommodate changes in direction during linkage movement and if adjustable must also be lockable.
- c) The adjustment facility to adjust the angle of the operation of the current path as well as travel of the operation of the current path shall be provided.
- d) Linkage rod ends shall be self-lubricated and shall be in continuous galvanic contact with the earthed portions of the equipment to prevent development of induced voltages.
- e) When the pole centres exceed 3 000 mm inter-phase linkages shall operate in tension only to avoid buckling. A concession in this respect requires ample evidence in the form of successfully performing the ice-breaking test on a fully representative gang-operated three pole unit. This shall be class 10 in accordance with SANS 62271-102 clause 6.103.

3.2.7.6 Adjustment facilities and stability of settings

- a) At points where stable and fine adjustment is necessary to achieve correct functional behaviour this shall be possible in a step-less manner. Typically preferred examples are right/left handed threaded components, slotted flanges and/or levers or other methods which makes it possible to achieve this function reliably during the life expectancy of the disconnecter.

NOTE: Use of round section U-bolt clamps and other similar methods for fine adjustment purposes is considered as not meeting this "step-less" requirement and is therefore not acceptable and is considered sufficient reason to reject a submission on technical grounds.

- b) Adjustment facilities shall be fixed by an approved method such as locknuts and shall not require drilling and pinning.
- c) Adjustment facilities and their fixings shall be designed for the life expectancy of the equipment.

3.2.7.7 Main HV terminal requirements and earthing path

- a) Main (HV) Terminals for disconnectors
 - i. The main HV terminals shall be in accordance with SANS 62271-301. For all Eskom system voltages, the main terminals shall be aluminium flat pad with 4 x 50 mm, 8 x 50 mm and 9 x 50 mm pitch (distance between holes) and having a minimum thickness of 20 mm. The diameter of the holes shall be 14 mm (M12). The pad thickness, hole diameter and pitch shall be specified in schedule A.
 - ii. At 11 kV to 66 kV four (4 x 50 mm) holes pad shall be acceptable. At 132 kV four (4 x 50 mm) are acceptable for nominal current rating of 2500 A, but for the nominal current ratings above 2500 A, then the eight (8 x 50 mm) holes pads are acceptable. Above 132 kV only eight (8 x 50 mm) and nine (9 x 40 mm) holes shall be acceptable.

NOTE: For the 220 kV and above disconnectors and earthing switches, an 9 hole aluminium flat pad with a 40 mm pitch having a minimum thickness of 20 mm shall be acceptable. The diameter of the holes shall be 14 mm (M12).

- iii. Continuous current (Temperature rise) and short-time current type tests for the equipment shall be carried out with the same type of terminal as will be supplied.

Dimensional details of the main HV terminals shall be shown on the disconnector general arrangement drawing.

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b) Earthing Switch main HV Terminals and earthing path

For earthing switches an earthing switch main HV terminal per pole shall be provided, suitable for a copper flat type conductor strap (50 mm x 3 mm) and shall be of sufficient size that the current density does not exceed 50 A/mm² based on the short time current rating of the earthing switch. Fixed contacts shall not open from setting if the moving contact is not aligned, contact must always make in the closed position.

For the stand alone (separately mounted) earthing switches, the following main terminals shall be provided:

- an 8 hole (2 x 4 hole pattern) aluminium flat pad with a 50 mm pitch (distance between holes) and having a minimum thickness of 20 mm for all voltages of 66 kV and above. The diameter of the holes shall be 14 mm;
- In the case where the steel support structure is supplied with the disconnecter and/or earthing switch, an additional M16 (Ø18 mm hole) hole shall be provided in the steel support structure approximately 100 mm above the base of the support structure (i.e. above the concrete foundation) for the connection of external earthing conductors.

Details of the disconnecter and earthing switch main HV terminals and earthing shall be provided on the general arrangement drawings as described under subclause 3.2.25 and 3.2.26.1.

3.2.7.8 Main Current Paths (including main contact and transfer contacts)

- a) Current paths (including its main contact assembly and transfer contacts) shall be designed for a minimum maintenance interval which is in accordance with its mechanical endurance Class as was demonstrated during type testing requirement of SANS 62271-102 subclause 7.102.3 and 7.103.5, and this shall be on the OEM operation and maintenance instruction manual. Eskom prefers a minimum interval period not to be less than twelve (12) yearly.
- b) For conventional disconnectors, current path assemblies shall consist of the top mechanism having a minimum sub component, (preferably one solid piece current path with replaceable contacts).
- c) Simple contact pressure arrangement with a simple a contact tension setting technique, and minimum moving parts shall be preferred which must self-align. This shall be demonstrated during factory accepted, and recorded on factory routine testing and where possible, during site testing.
- d) Pantograph type disconnectors shall have current path designs which eliminate the need for major overhauling, other than at the main contact zone. This includes the main trapeze contact and its mounting accessories that clamps to the Eskom busbar conductor types tubular and flexible (Single, Twin and triple Bull).
- e) Copper contacts shall be tinned on the bolted side and silver plated on the contact side.
- f) Bird nesting shall not interfere with the functionality of the disconnecter.

3.2.7.9 Post Insulators

- a) Post insulators shall comply with the requirements of SANS 60273 and SANS 60815.
- b) The type of post insulator material shall be porcelain or composite. The type of insulator material offered and manufacturer shall be stated in schedule B.
- c) Solid-core post insulators:-
 - i. For ceramic insulators, consisting of glass or porcelain, SANS/IEC TS 60507, "Artificial pollution tests on high-voltage ceramic and glass insulators to be used on a.c. systems", shall apply.
 - ii. All composite or polymeric high voltage insulators shall conform to, the 1000hr salt-fog tracking and erosion test, contained in SANS/IEC 62217, "Polymeric HV insulators for indoor and outdoor use – General definitions, test methods and acceptance criteria" as a minimum or the minimum pollution related qualification as contained in the specific international (SANS, IEC, IEEE, ANSI etc.) equipment or product standards

SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED SWITCHGEAR RATED FOR VOLTAGES 1 KV AND ABOVE – OUTDOOR DISCONNECTORS AND EARTHING SWITCHES

Unique Identifier: **240-180000569**

Revision: **1**

Page: **27 of 91**

- Firstly comply with the clauses above (i. and ii.) for polymer and ceramics respectively, also with SANS/IEC 62217 as a minimum requirement, and the Supplier shall provide the relevant accredited reports and certification with the tender documentation.
- Additionally, the qualification for heavy and very heavy pollution levels shall be provided based on certification of products meeting **either one** or **a combination of** the following technical standards or guidelines provided in Table 6: Test Standards or Methods applicable for heavy to very heavy pollution site severity. It should be noted that the requirements listed are not in any order of preference:-

Table 6: Test Standards or Methods applicable for heavy to very heavy pollution site severity

Standard Identifier	Title/Nature of test
SANS/IEC TS 60507	Artificial pollution test on high-voltage insulators to be used on a.c. systems
CIGRE TB 555	Artificial pollution test for polymer insulator, WG C4.303
CIGRE TB 691	Pollution test of naturally and artificially contaminated insulators, WG D1.44
SANS/IEC TR 62730	HV polymeric insulators for indoor and outdoor use tracking and erosion testing by wheel test and 5000hr test
SANS/IEC 60815 (or any of the preceding tests mentioned)	Pollution flashover performance curve tests

- d) Post insulators from the same Supplier and type shall be supplied per item of equipment.
- e) Mixing of post insulator makes and type per item of equipment is not permitted.
- f) Details of the post insulator such as manufacturer, type designation, creepage dimensions and shed profile shall be submitted with the tender documentation.
- g) The standard colour for post insulators shall be dark brown, if porcelain.
- h) There shall be exact interchangeability between post insulators irrespective of the supplied creepage distance.
- i) Minimum creepage distances
 - The minimum unified specific creepage distance (USCD) required in accordance with SANS 60815-1 for external insulation shall be as specified in Schedule A. The unified specific creepage distance (USCD) for external insulation has been rationalised to:-
 - 34,7 mm/kV for "c - medium" site pollution severity (SPS) class;
 - 43,3 mm/kV for "d - heavy" site pollution severity (SPS) class; and
 - 53,7 mm/kV for "e - very heavy" site pollution severity (SPS) class.

NOTE: 34,7 mm/kV, 43,3 mm/kV and 53,7 mm/kV corresponds to a previous specific creepage distance (SCD) of 20 mm/kV, 25 mm/kV and 31 mm/kV respectively.

- Eskom Transmission has standardised on insulators that meet the minimum creepage distance of SCD of 31 mm/kV i.e. USCD of 53,7 mm/kV. The actual creepage distance offered shall be stated in Schedule B.

- j) Clearances in air
 - i. The Eskom Transmission specified minimum phase-to-phase clearances are based on the fact that twin bull conductors are required for the current rating of 2500 A, and triple-bull conductors for 3150 A and 4000 A. The minimum phase-to-phase clearance, measured by the taut string method on the outer of metal-to-metal (outer of main HV terminal pad to pad) of single-mechanism type disconnectors and earthing switch, shall be as shown under subclause 3.2.7.10:

NOTE: Eskom Transmission reserves the right to call for clearances greater than those already successfully proven by dielectric tests.

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- ii. phase-to-phase (phase spacing) and phase-to-earth clearances, measured by the taut-string method, shall be shown on the general arrangement, and when specified in the Schedule A then the Supplier shall provide disconnector or earthing switch that meets the Eskom Transmission requirement.

3.2.7.10 Phase spacing on substation layout:

- a) For disconnectors and earthing switches specified for 22 kV, they shall be offered with phase spacing of 1 000 mm, for 33 kV the phase spacing of 1 200 mm, and for 66 kV the phase spacing of 2 000 mm.
- b) For 132 kV: all disconnectors and earthing switches should be offered with phase spacings of 2 400 mm and 3 000 mm.

The Supplier and their OEM factory of the pantograph type disconnector shall take note of these conductor phase spacings when designing the pantograph pole spacing (diagonal) arrangement. This includes the pantograph disconnectors that are with integral earthing switches.
- c) For 275 kV (also used on 220 kV network):: all disconnectors and earthing switches should be offered with phase centres of 4 300 mm, 5 500 mm and 6 700 mm. The 5 500 mm dimension is standard for tubular bus bar designs. Pantographs shall not be offered with the phase spacing dimensions as the poles shall not be interlinked through drive rods.
- d) For 400 kV: all disconnectors (conventional type and pantograph type) and earthing switches should be offered with phase centres of 5 500 mm, 6 500 mm and 7 010 mm. The 5 500 mm dimension is standard for tubular bus bar designs. Pantographs shall not be offered with the phase spacing dimensions as the poles shall not be interlinked through drive rods.
- e) For 765 kV: all disconnectors and earthing switches should be offered with phase centres of predominantly 14 000 mm and few requirements of 11 000 mm.

3.2.8 Operation Interlocks between Disconnector and Earthing Switch

The disconnector and earthing switch in terms of its interlocking or locking devices shall comply to the SANS 62271-102 subclause 6.12, and proof of type-testing of mechanical interlocking as per SANS 62271-102 subclause 7.102.6.

3.2.8.1 Facilities shall be provided to mechanically Interlock the Respective Drives so that:

- a) The in-built earthing switch can only be closed when the disconnector is fully open
- b) The disconnector can only be closed when the in-built earthing switch is fully open.

3.2.8.2 Electrical Interlocks:

- a) Remote operation is blocked when the main access door is open, and this must be shown on the wiring schematic.
- b) Electrical supply to the motor is isolated when the manual operating handle is inserted.
- c) The earth switch shall also be electrically interlocked with the disconnector (when fitted with integral earth switches).

3.2.8.3 Indicating Devices

A mechanical indicating device shall be provided at each mechanism to indicate the open or closed position.

3.2.8.3.1 The following symbols shall be used:

- a) Device *closed* "ON" in white lettering on a red background
- b) Device *open* "OFF" in white lettering on a green background

- c) Lettering size shall be at least 20 mm.

3.2.9 Nameplates

- a) Every disconnecter and earthing switch shall be provided with a rating plate mounted on an earthed vertical flat surface so that a normally sighted person standing at ground level can easily read the details.
- b) The nameplates and their fixings shall be weather and corrosion proof and shall be stated in schedule B.
- c) Nameplates shall be either engraved aluminium or stainless steel and are subject to approval by Eskom. The nameplates shall be securely fastened to the equipment in a reliable manner. The nameplate material offered shall be stated in schedule B.
- d) The disconnecter nameplate shall contain the necessary information specified in SANS 62271-102 subclause 6.11 and its Table 12 and the following:
- Eskom Transmission contract number and purchase order number
 - Eskom Transmission GA drawing number and its applicable Eskom material (SAP) number
 - Type designation – also showing if it has integral earthing switch (1-LH; 1-RH; 2-ES)
 - Mechanical endurance class
 - Main contact resistance (terminal to terminal) as per type test evidence
 - Rated duration of short-circuit
 - Rated bus-transfer current
 - Rated bus-transfer voltage
 - Rated contact zone
 - Rated ice-coating
 - Insulation creepage distance (creepage to ground)

NOTE: Actual true type test values to which the equipment has been certified shall be displayed.

- e) The earthing switch nameplate shall contain the necessary information specified in SANS 62271-102 subclause 6.11 and its Table 12 and the following:
- Eskom Transmission contract number and purchase order number
 - Eskom Transmission GA drawing number and its applicable Eskom material (SAP) number
 - Rated duration of short-circuit
 - Rated short-circuit making current
 - Rated induced current (electromagnetic)
 - Rated induced voltage (electromagnetic)
 - Rated induced current (electrostatic)
 - Rated induced voltage (electrostatic)
 - Rated contact zone
 - Class of earthing switch (class A or B)
 - Mechanical endurance class
 - Rated ice-coating
 - Insulation creepage distance (creepage to ground)

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NOTE: Actual true type test values to which the equipment has been certified shall be displayed.

The operating device nameplate shall contain the necessary information specified in SANS 62271-102 subclause 6.11 and its Table 12. In instances where motor and manual operated drives are supplied, a separate rating plate shall be provided giving details of the operating drive itself. This rating plate shall be a separate rating plate to the above and mounted outside the operating drive itself. In addition to the manufacturer's name and type designation it shall display the following information:

- Eskom Transmission contract number and purchase order number
- Rated supply voltage of auxiliary and control circuits (U_a)
- Serial number
- Year of manufacture
- Rated ice-coating
- Mechanical endurance class

NOTE: These values shall be the nominal values (with tolerances) according to the routine test parameters.

- a) The nameplates and their fixings shall be weather-proof and inherently corrosion-resistant. They shall be either engraved aluminium or stainless steel and are subject to approval by Eskom. All the letters and figures on the nameplates shall be permanently marked. The nameplates shall be securely fastened to the equipment in a reliable manner (refer to subclause 3.2.10). The method used shall be stated in Schedule B. The nameplate material offered shall be stated in Schedule B.
- b) The actual ratings to which the disconnecter or earthing switch has been type-tested (and not merely the values specified) shall be displayed.

3.2.10 Operating Labels

Where a support structure is required, the support structure shall make provision for the secure attachment of operating labels. The position and orientation of the labels shall be such that they are visible from the ground level.

Operating labels associated with the disconnecter and earthing switch shall be black text on white background, in English.

Where applicable, all labels shall be manufactured in accordance with applicable Eskom Transmission standards (240-120804300 and 240-62629353) and shall be attached using inherently corrosion-resistant rivets or self-tapping screws. No stick-on labels, double sided tape nor glue is accepted, unless otherwise approved by Eskom Transmission.

All relays, fuses, MCBs, control switches, luminous indicators and links, the functions of which are not clearly identified by signs or pictograms, shall be clearly labelled to indicate their functions. These labels shall be in text using black letters at least 5 mm high on a white background.

An appropriate warning label shall be displayed to draw attention to the danger of performing manual operations that is unsafe for personnel.

3.2.11 Operating mechanisms

3.2.11.1 Manually Operated Mechanism

- a) Eskom Transmission shall specify the required type of mechanism operation in schedule A. The Supplier shall state the type of offered mechanism in schedule B.

For Eskom Transmission operating personnel to safely operate the disconnecter and earthing switch, manually, it shall be designed such that the force needed to operate it is 250 N in accordance with the SANS 62271-102 subclause 5.6.3.

NOTE: The operating force applicable during type testing shall have been of a minimum of 200 N and not exceeding 750 N as per SANS 62271-102 subclause 7.105.

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- b) Manually operated mechanisms shall be evaluated and approved by Eskom. The process shall be assisted by means of samples, drawings and descriptive literature. The Supplier shall provide all these requirements with the tender documentation.
- c) Mechanism considered “acceptable” shall have the following design features:-
- iii. A robust steel handle of not less than 40 mm or greater than 55 mm outside diameter;
 - iv. The operation of swing type handles takes place in the horizontal plane.
 - v. The operation of crank type handles takes place in a vertical plane.
 - vi. The height for the operating handle is between 1000 mm and 1200 mm above ground level.
 - vii. The length of a swing type handle is between 750 mm and 1200 mm.
 - viii. The output shaft is galvanically connected to the substation earth mat via the support structure by means of a multi-stranded insulated flexible copper conductor of at least 65 mm² cross-sectional areas.
 - ix. There is adequate physical clearance to prevent injury to operating personnel.
 - x. There are padlocking facilities provided in both the “open” and “closed” positions.
 - xi. There are padlocking facilities suitable for an Eskom Transmission standard padlock with an 8 mm shank or shackle.
 - xii. The open and closed positions are positively identified at the mechanism with labels “ON” and “OFF” respectively.
 - xiii. A reduction gear box type mechanism shall require a maximum revolution of fifty (50) turns for a full operating cycle.
 - xiv. The direction in which to achieve open and close is clearly indicated.
 - xv. There is a fixed door-stop provided on all hinged doors. The facility shall be robust enough to withstand the force of wind (refer to subclause 3.2.2 iv).
 - xvi. The operating mechanism enclosure, handles and fixings shall be manufactured from 3CR12 stainless steel with corrosion protection in accordance with subclause 3.2.14, unless otherwise approved by Eskom.

3.2.11.2 Motor Operated Mechanism

- a) Eskom Transmission shall specify the required type of mechanism operation in schedule A. The Supplier shall state the type of offered mechanism in schedule B.

Also the manual operation of the motor-operated drive mechanism shall be in accordance with this standard specification subclauses 3.2.22, which is in accordance with SANS 62271-102 subclause 6.105.

- b) It shall be possible to change the d.c. control voltage at which the disconnector operating drive mechanism operates by only replacing the operating mechanism motors and motor contactor coils.

NOTE: Switchgear shall be required to operate at one of two dc. control voltage reliably i.e. the closing and opening devices, operating mechanism motors and motor contactor coils to be supplied with the switchgear are required to be suitable for operation at either 110 V dc. or 220 V dc. as specified in schedule A.

- c) A readily available dc. supply voltage "conversion kit" may be required by Eskom Transmission from the Supplier in order to convert the disconnector operating mechanism from 110 V to 220 V dc or vice versa.
- d) Motors shall be designed, rated and tested to the relevant IEC requirements and for the operating voltage specified in Schedule A.

SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED SWITCHGEAR RATED FOR VOLTAGES 1 KV AND ABOVE – OUTDOOR DISCONNECTORS AND EARTHING SWITCHES

Unique Identifier: **240-180000569**

Revision: **1**

Page: **32 of 91**

NOTE: The use of resistors to reduce the supply voltage to motors is not acceptable. The method used to achieve immunity to spurious operation due to induced surges in the control cables is subject to approval by Eskom Transmission. The Supplier shall provide all details with tender documentation.

- e) Motor operated mechanisms shall be evaluated and approved by Eskom. The process shall be assisted by means of samples, drawings and factory visits. The Supplier shall provide all these requirements with the tender documentation.
- f) Mechanism considered “acceptable” shall have the following design features:-
- i. The output torque and operational characteristics are optimally matched to the driven equipment.
 - ii. The speed of operation and end of motion drive characteristics takes place with no “bounce-back” action.
 - iii. In the case of overloading and attendant risk of mechanical damage, supplies to the motor circuit and control contactor circuits of all poles is immediately interrupted and alarm signalling provided for this condition.
 - iv. Resetting of overload devices results in a neutral condition and it is possible to reverse the drive from the original direction it was travelling when the overload occurred.
 - v. A manual operation facility is provided by means of a device such as a crank handle with clear indication of direction to operate towards both open and closed conditions.
 - vi. The main access to the mechanism interior is provided with a padlocking facility to accept an Eskom Transmission standard padlock with an 8 mm shank or shackle.
 - vii. For electrical and mechanical interlocks, refer to subclause 3.2.8.
 - viii. There is a three-position switch labelled “local-off-remote” as well as two separate push buttons, one labelled “ON” to close the main contacts and the other one labelled “OFF” to open the main contacts.
 - ix. It shall be practicable to measure the motor operational current by means of a “clip-on” type ammeter.
 - x. There is ample accessibility to key components such as motors and auxiliary switches without the necessity of having to remove wiring to other components inside the mechanism box.
 - xi. The output shaft is galvanically connected to the substation earth mat via the support structure by means of a multi-stranded insulated flexible copper conductor of at least 65 mm² cross-sectional areas.
 - xii. It is required to mechanically disconnect and reconnect the drive for purposes of functional testing of the drive and controls whilst the main contacts are fully open and without affecting the final adjustment of the equipment.
 - xiii. The open and closed positions are positively identified with labels “ON” and “OFF” respectively.
 - xiv. Open type motors and gears shall not represent a hazard when local operation is in progress.
 - xv. There is a fixed door-stop provided on all hinged doors. The facility shall be robust enough to withstand the force of wind in accordance with subclause 3.2.2) iv.
 - xvi. The operating mechanism enclosure, handles and fixings shall be manufactured from 3CR12 stainless steel with corrosion protection in accordance with subclause 3.2.14, unless otherwise approved by Eskom Transmission.
 - o No moisture ingress into auxiliary switches.
 - o Moisture anti-condensation heaters.
 - o IP 55 classification.

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- Misalignment of auxiliary switches shall not be possible.

Where lubrication is necessary no dismantling of gearboxes or gear trains shall be necessary. Motor bearings shall be of the sealed type.

3.2.12 Auxiliary and control equipment and circuitry

The SANS 62271-102 subclauses 6.4 shall be applicable with the following additions:-

The auxiliary and control circuits shall be designed and implemented in accordance with this standard specification requirements listed below **Table 7**, and the Eskom Transmission standard wiring interface drawings applicable for that voltage offered disconnector or earthing switch.

Table 7: Eskom Transmission standard wiring interface drawings for disconnectors and earthing switches

Type	DS/ES Rating [kV]	System voltage [kV]	Rated DC Voltage (V)	Standard wiring interface drawing applicable	Wiring Schematics from the Supplier required
Disconnector (conventional) – Hand Operation	22, 33, 66, 132	11 ¹⁾ , 22, 33 ²⁾ , 66 ³⁾ , 88 ⁴⁾ , 132	110, 220	0.54/07858	Yes ⁹⁾
Disconnector (conventional) – Motor Operation	33, 66, 132	11 ¹⁾ , 22 ¹⁾ , 33 ²⁾ , 66 ³⁾ , 88 ⁴⁾ , 132	110, 220	0.54/07858	Yes ⁹⁾
Disconnector (conventional) – Motor Operation	275, 400, 550, 765	220 ⁶⁾ , 275, 400 ⁶⁾ , 765	110, 220	0.54/07858	Yes ⁹⁾
Disconnector (Pantographs) – Motor Operation	132, 275, 400, 550	88 ^{4,5)} , 132 ^{4,5)} , 220 ⁶⁾ , 275, 400 ⁷⁾	110, 220	0.54/07861	Yes ⁸⁾
Earthing switches – Hand Operation	22, 33, 66, 132	11 ¹⁾ , 22, 33 ²⁾ , 66 ³⁾ , 88 ⁴⁾ , 132	N/A	0.54/07129	Yes ⁹⁾
Earthing switches	275, 420, 550, 765	220 ⁶⁾ , 275, 400 ⁷⁾ , 765	N/A	0.54/07129	Yes ⁹⁾
Single-pole disconnector (conventional/ pantograph) or ES		+/- 533 DC		TBA ⁸⁾	Yes ⁹⁾

NOTES:

- a) The 11 kV and 22 kV system voltage uses 22 kV and 33 kV rated disconnectors and earthing switches.
- b) The FACTS application of 15 kV and 30 kV system voltage uses 33 kV rated disconnectors and earthing switches. Also the disconnectors employing Motor Operation begin from this voltage in-order to cater for FACTS requirements (Live-chamber yards).
- c) The 44 kV system voltage uses 66 kV rated disconnectors and earthing switches.
- d) The 88 kV system voltage uses 132 kV rated disconnectors and earthing switches.
- e) The vertical isolation requirement on 88 kV system voltage shall use 132 kV rated disconnectors (pantographs).
- f) The 220 kV system voltage uses 275 kV rated disconnectors and earthing switches.
- g) The 400 kV system voltage uses both 420 kV and 550 kV rated disconnectors and earthing switches.
- h) Standardised drawings are not (yet) available.
- i) Supplier shall submit with tender documentation, the wiring schematics that are aligned to Eskom Transmission standard wiring interface terminal numbering drawings.

3.2.12.1 Control Cables and Gland Plates

- a) Control cables terminated inside enclosures shall enter at the bottom of the enclosure.
- b) Cables shall be of the PVC covered steel wire armoured multiple core type fitted with armour grip type glands.
- c) Gland plates shall be removable, undrilled and made of brass or corrosion resistant aluminium alloy. Steel gland plates are not acceptable.
- d) Suitable gasket (refer to subclause 3.2.13.1 p)) to be fitted between the mechanism box and the gland plate.

3.2.12.1.1 Dimension of the Gland Plate

The dimension of the gland plates shall be as follows:-

- a) Minimum available area of the gland plate shall be at least 75 mm x 75 mm for manual operated disconnectors of 66 kV and below voltages. For all other disconnectors, the minimum usable area shall be 100 mm x 150 mm.
- b) Minimum thickness at least 2 mm (for brass) or 4 mm (for aluminium).
- c) Where applicable, metallic cable racking used to mechanically protect and/or support disconnector and earthing switch cabling (e.g. inter-pole cabling) shall be manufactured using galvanized steel, unless otherwise approved by Eskom.

NOTES:

- a) The use of aluminium cable racking is considered to present a theft risk and will not be accepted.
- b) Where Eskom Transmission support structure legs are provided, no provision is made for securing or mounting inter-pole cable racking on the legs – requiring the (armoured) inter-pole cabling to be buried in the ground, unless otherwise approved by Eskom.

3.2.12.2 Secondary Terminals

- a) Auxiliary switches, internal wiring and other equipment requiring connection to external apparatus shall be wired to terminal strips in the disconnector mechanism box. These must be approved in writing by Eskom.
- b) Each terminal strip shall be provided with not less than 4 spare terminals.
- c) The arrangement of the terminal strips (vertical orientation) in the equipment shall facilitate the entry of the incoming control cables in the bottom-entry configuration.
- d) Secondary terminals to which Eskom Transmission's control cables shall be terminated to comply with Eskom Transmission standard (240-64636794).
- e) The terminal blocks shall be of the screw clamp, spring loaded insertion type.
- f) The terminal width of 10 mm is the preferred option.
- g) The terminal blocks shall be capable of accepting back-to-back insulated hook blade lugs without damaging or deforming the lug.
- h) All electrical circuits for external connection shall be terminated at a secondary terminal strip.
- i) The secondary terminal strips shall be arranged vertically or horizontally within the enclosure.
- j) For horizontally arranged secondary terminals, the lowest part of the terminal strip shall be at least 150 mm above the gland plate.
- k) For vertically arranged secondary terminals this value may be less than 150 mm above the gland plate provided sufficient clearance to the sides of the enclosure is provided for arranging and terminating the incoming cable cores, and wiring bundle and working clearance.

- l) The secondary terminals shall be of the DIN rail-mounted spring-loaded type. An Eskom Transmission approved type of terminal shall be supplied. The Supplier shall submit the sample with the tender documentation for Eskom Transmission approval.
- m) At least 4 spare terminals shall be provided.

3.2.12.3 Secondary Wiring

- a) All wiring shall be carried out in multi-stranded copper conductor. A minimum equivalent area of 2, 5 mm² for motor circuits and 1.5 mm² for other circuits which is insulated to withstand a routine test voltage of 2 kV for 60 s shall be provided.
- b) Each individual wire must be terminated with lugs suitable for the secondary terminal block or component terminal used. Bare wire ends are not acceptable.
- c) Wiring shall be clearly identified by an approved means such as ferruling at both ends or laser etching of the insulation.
- d) Thermal impression of the insulation or adhesive labels as a means of wiring identification is not acceptable.
- e) Wiring to components mounted on swing frames shall be arranged to twist at and along the hinge point.
- f) The internal wiring interface of the operating mechanism enclosure shall be standardised in accordance with the Eskom Transmission interface standard drawings, for disconnectors 0.54/07858 and 0.54/07861 and for earthing switches 0.54/07129; and the marking in accordance with 240-64636794, or otherwise on a drawing stated in schedule A.

All workmanship with regards to the above shall be subject to Eskom Transmission approval.

3.2.12.4 Control Elements

- a) All control elements such as contactors, thermal overload relays, push buttons and limit switches shall be in accordance with the relevant IEC standards.
- b) All control elements shall be regular stock items available from standard product lines.
- c) The control elements shall be readily interchangeable with an equivalent item from alternative Suppliers. All Mounting of control elements on access doors is not acceptable practice.
- d) All control elements must be labelled with their locations inside the drive.
- e) The location of the label shall be on the backing plate where the relays are fixed in order to retain the labelling should the relay be changed during its life time.

3.2.12.5 Auxiliary Switches

- a) Auxiliary switches shall be of an approved type. Eskom Transmission shall assess the sample provided by the Supplier with the tender documentation, to determine its acceptability or not. If it does not meet Eskom Transmission approval, then the offered type shall be treated as technical deviation that needs to be addressed by the Supplier.
- b) Auxiliary switches shall be rated according the values specified in schedule A. The Supplier shall state the rating of the auxiliary switch in schedule B.
- c) Auxiliary switches shall be driven positively and the linkage system employed shall ensure correct action throughout the operation.
- d) The number and type of auxiliary contacts required for each mechanism shall be as specified in schedule A. The Supplier shall state the number and type of auxiliary contact in schedule B.
- e) Auxiliary switch contacts shall be galvanically independent.
- f) All spare auxiliary switch contacts shall be wired to the secondary terminal strip.

- g) Auxiliary switch contacts shall be protected against ingress of dust particles to the degree of protection IP55.
- h) Auxiliary switches shall faithfully reproduce the main contact position and achieve the relative timing parameters required.
- i) The auxiliary switch shall be a truly maintenance free device for the life of the equipment.
- j) The timing of the designated auxiliary contact types shall be according to the figure below:
- k) Switches shall always stay aligned and shall not bend if main contacts become stiff to operate.
- l) Auxiliary switches shall not be placed directly under shaft seals where water can enter.

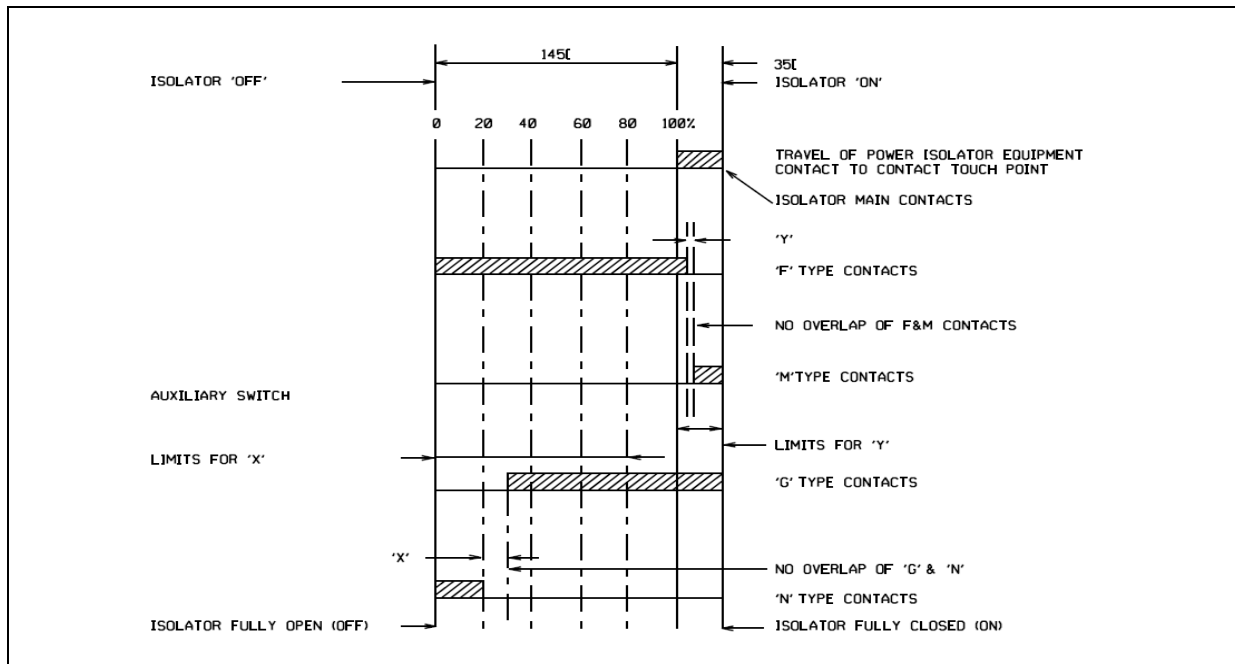


Figure 1: Auxiliary switch contacts timing diagram

3.2.12.6 Convention / Practice

The convention has been adopted that auxiliary contacts, limit switches, relay contacts etc. are in the normal condition when:

- a) Disconnecter and/or earthing switch main contacts are open;
- b) Relay coils are de-energised.

The schematic wiring diagram submitted to Eskom Transmission for design purposes and final approval shall reflect this convention which is in accordance with Eskom Transmission wiring interface drawing.

3.2.13 Enclosures requirements

3.2.13.1 General Design

The enclosures for disconnecter and earthing switch shall be designed and manufactured in accordance with SANS 62271-102.

- a) The enclosures for disconnecter and earthing switch shall be designed for facilitating access to the innards as well as preventing unauthorised access to controls in the case of motor operating mechanisms. Disconnecter and earthing switch operating mechanisms, local control facilities and all parts requiring lubrication shall be protected by weatherproof enclosures.

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- b) The design of the enclosure shall be such that access to the control circuitry can be obtained when the operating handle is either locked in the open/closed position.
- c) The operating mechanism enclosure, handles and fixings shall be manufactured from 3CR12 stainless steel with corrosion protection in accordance with 3.2.14. Only if offered for hand operated mechanism, the use of factory coated aluminium shall be considered if corrosion protection is in accordance with 3.2.6.
- d) Operating mechanism enclosures shall be arranged to facilitate easy access for operation by manual operation handle without personnel leaving ground nor requirement of use of ladders. This shall also allow for inspection and scheduled maintenance which may include permissible in-situ cleaning, lubrication, repairs and adjustments to the operating drive mechanism. The maximum height shall be such that it allows personnel without leaving ground, to perform operation by manual operation handle and inspections.
- e) Any removable covers provided shall have bolt fastenings, subject to Eskom Transmission approval. All bolts shall be inherently corrosion resistant and have hexagon heads. Self-tapping screws, captive head nuts or cage nuts are not acceptable.
- f) The disconnecter and earthing switch shall be designed for operation from the front of the operating mechanism enclosure. At this position on a disconnecter, it will be basis of identifying the position of the earthing switch if located Left Hand or Right Hand.
- g) Access to the operating mechanism enclosure(s) shall be through a hinged access door allowing accessibility to components installed in the enclosure (e.g. control levers, push-buttons, MCBs and secondary wiring terminal strips) in accordance with SANS 62271-1.
- h) The front access door shall be secured with a heavy-duty locking mechanism. The operating mechanism enclosure shall be capable of being padlocked to prevent unauthorized access. The locking facility shall accommodate padlocks that have a diameter of 8 mm shank or shackle.
- i) The front access door of the operating mechanism enclosure shall be equipped with a travel stop, which shall retain the door in the open position. The facility shall be robust enough to withstand the force of wind in accordance with subclause 3.2.2 a) iv.
- j) A rigid, corrosion resistant, documentation pocket shall be provided for the safe-keeping of all relevant documentation (i.e. the installation, operating and maintenance instructions for the disconnecter and earthing switch and all routine test certification), on the inside of the operating mechanism enclosure front access door. The documentation pocket shall be securely attached and the means used (e.g. pop rivets) to secure the pocket shall not protrude through the door.
- k) Suitable facilities for storage and securing of the hand-operating tool(s) shall be provided on the inside of the operating mechanism enclosure front access door
- l) Earthing of the operating mechanism enclosure shall be via the steel support structure (e.g. via the common base frame and support legs via the steel column support).

If additional/ visual earthing is required for the operating mechanism enclosure, all earthing terminals, fastenings and conductors shall be supplied and fitted by the Supplier and will be subject to approval by Eskom Transmission. In the latter case, the conductors shall be kept as short as possible and the earthing terminal on the operating mechanism enclosure shall be located towards the top of the enclosure housing. Earthing conductors shall be manufactured using galvanised steel. A 30 mm long, Ø25 mm (min) metallic boss, with an M12 thread throughout and welded to the equipment shall be used for all external earthing conductor fastenings. The boss shall be fitted with a M12 x 25 mm long setscrew, washer and spring washer. The boss and the setscrew on the enclosure shall be stainless steel of grades 304 and 316, respectively, unless otherwise approved by Eskom Transmission. The boss and the setscrew on the disconnecter and earthing switch steel support structure (e.g. the common base frame or the steel column support) shall be galvanised steel.

NOTE: The use of copper or aluminium is considered to present a theft risk and will not be accepted if metal is visually exposed. Such method shall meet subclause 3.2.14. The proposal to prevent visual exposure shall be presented to Eskom Transmission for approval with the tender documentation.

- m) Operating mechanism enclosures shall make provision for the entry of Eskom Transmission control cabling from below. Refer to subclause 3.2.12.2 c) for the requirements of the control cable entry gland plates.

NOTE: The use of plug-in type cable is not acceptable. Eskom Transmission prefers the normal gland plate and terminations made on terminals.

- n) Where applicable, metallic cable racking used to mechanically protect and/or support disconnector and earthing switch cabling (e.g. inter-pole cabling) shall be manufactured using galvanized steel, unless otherwise approved by Eskom Transmission.

NOTES

- a) The use of aluminium cable racking is considered to present a theft risk and will not be accepted.
 - b) Where Eskom Transmission support structure legs are provided, no provision is made for securing or mounting inter-pole cable racking on the legs - requiring the (armoured) inter-pole cabling to be buried in the ground, unless otherwise approved by Eskom Transmission.
 - c) The use of plastic material cable ties shall not be accepted.
- o) Upper surfaces of enclosures shall be shaped or sloped to prevent the accumulation of water.
- p) Gaskets shall be made of neoprene rubber, nitrile rubber or cork, unless otherwise approved by Eskom Transmission. Felt or natural rubber gaskets are not acceptable. The gasket material offered shall be stated in Schedule B.
- q) A gauze-covered drain hole with a minimum diameter of 25 mm and having no internal rim or ledge that is likely to obstruct drainage shall be provided at the lowest point of the operating mechanism enclosure.
- r) Where applicable, suitable lifting eyes shall be provided at the top of the operating mechanism enclosure. The lifting eyes shall be designed to provide for the lifting of the complete operating mechanism enclosure. Lifting eyes with a minimum diameter of 30 mm shall be provided.
- s) The colour for the enclosure shall be "light grey" (G29) in accordance with SANS 1091 unless otherwise specified in Schedule A or approved by Eskom Transmission. The closest equivalent RAL colour shall be considered.

The Supplier shall provide with the tender documentation the information on each supplied equipment type specified below: disconnector and earthing switch operating mechanism enclosure anti-condensation heaters, where applicable:-

- i. Suitably rated electric heater(s) shall be installed to prevent moisture condensation inside the disconnector and earthing switch operating mechanism enclosure. The heater size offered shall be stated in Schedule B.
- ii. Heaters shall maintain a dew-point greater than the ambient temperature and shall circulate the air constantly to all parts of the enclosure.
- iii. The electrical supply for anti-condensation heaters shall be single-phase 230 V a.c.

Heater control and alarm circuits shall comply with the Eskom Transmission secondary wiring requirements and standard wiring interface drawings.

3.2.13.2 Degrees of Protection

The degree of protection provided by enclosures shall be in accordance with SANS 62271-102 subclause 6.14, with the following minimum requirements in accordance with SANS 60529. The degree of protection offered shall be stated in Schedule B.

- enclosures containing exposed bearings, auxiliary switches, motors and other electrical devices shall comply with IP 55 (i.e. operating mechanism enclosure).
Operating mechanism enclosures for disconnectors and earthing switches for outdoor installation shall be a minimum of IP 3XDW of IEC 60529. Those enclosures for indoor installation (for GIS) shall be a minimum of IP 2X of IEC 60529;

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- where applicable, all open areas in the disconnecter and earthing switch common base frame and linkages where there is a high probability of birds nesting, shall be suitably covered to IP 2X of IEC 60529; and
- all other enclosures provided shall comply with minimum IP 54 of IEC 60529.

Upper surfaces of enclosures shall be shaped or sloped to prevent accumulation of water. There are no nesting places for insects such as wasps or bees nor allows the accumulation of water and/or debris.

3.2.13.2.1 Sealing

- a) Where components require sealing from the environmental elements the effectiveness of sealing shall be maintained for the normal service life of the equipment. This includes prevention of moisture accumulation inside sealed off areas. Besides the mechanism enclosure this also refers to enclosed type current transfer contacts, output shafts, bearing housings, fixing bolts and control cubicles.
- b) The method of sealing of doors and other items such as output shafts shall be subject to approval by Eskom. What Eskom Transmission considers acceptable are the following features on the design offered:-
 - i. No seals are exposed directly to the environmental elements.
 - ii. Seals on doors and removable panels are of extruded EPDM rubber or heavy duty foamed polyurethane.
 - iii. Natural rubber or felt seals are not acceptable.
- c) Anti-condensation Heaters
 - i. To prevent internal condensation, motor drive mechanisms shall be provided with suitably rated permanently connected electric anti-condensation heaters.
 - ii. The heater power shall be matched to the internal volume of the enclosure and shall not cause damage to internal components.
 - iii. The heaters shall be located at the bottom of the enclosure and in conjunction with suitably located vents shall circulate dry air constantly to all parts of the enclosure.
 - iv. The heaters shall be mounted separately from the secondary terminal strip.
 - v. The heater elements shall be shrouded and leads to the heater elements insulated by means of silicon rubber or ceramic beads not PVC.
 - vi. The electrical supply for heaters is 230 Volts ac.
 - vii. It shall be possible to isolate the heater by means of an approved isolating device.
 - viii. The heater control circuits shall comply with the requirements of Eskom Transmission secondary wiring interface standard drawings, 0.54/07129; 0.54/07858; 0.54/07860 and 0.54/07858, or a drawing stated in schedule A.

3.2.13.2.2 Lubricants such as Greases and Similar Compounds

- a) The performance of lubricants such as greases and similar compounds shall be proven as adequate for the intended purpose and application and shall not degrade during the application period.
- b) The Supplier is required to submit with the tender documentation a list of the lubricants and or compounds used, in the form of tests carried out to prove suitability for the intended purpose, including that of providing a barrier against atmospheric influence and/or corrosion inhibition.
- c) The sources of these lubricants and compounds (including Southern African sources), shall be provided. All liquids or chemicals shall be supplied with Material Safety Data Sheets (MSDS).

3.2.14 Corrosion protection and lubrication

All disconnectors and earthing switches shall be designed to the same level of corrosion resistance and the design shall be suitable for the most onerous corrosive environment.

NOTES:

- a) Service experience has shown that corrosion has a major influence on the performance of the equipment.
- b) Corrosion of components in the main current path and the mechanical drive system is a common cause of failure. Since it is a major exercise to gain access to such components and the resultant maintenance work often compromises reliability of the substation and the interconnected network, long-term resistance against corrosion is the foremost requirement of the equipment.
- a) All exposed metal shall be protected against corrosion in accordance with 240-75655504 for outdoor “high” to “very high” ‘C4’ and ‘C5’ (i.e. marine) corrosivity rating environments.
- b) The minimum detailed specification (“DS”) for all exposed metal in accordance with 240-75655504 shall be “DS-11” (3CR12), ‘DS-18 (Stainless steel) and ‘DS-13” (Hot-dip galvanised).

NOTE: Plastic or fibre-reinforced plastic materials for operating mechanism enclosures, or other applications where exposure to the elements is involved will be not accepted.

- c) The corrosion protection system (i.e. the equivalent detailed specification “DS” number in accordance with 240-75655504) offered by the manufacturer for the following components shall be stated in Schedule B. Details shall be provided with the tender documentation (refer to subclause 3.2.26.1):
 - enclosures;
 - nuts, bolts, studs and washers;
 - bearing assemblies and linkages;
 - structural steel (i.e. common base frame, support structure legs, etc.); and
 - other exposed metal (excluding main HV terminals).
- d) The behavior of lubricants that are exposed to air, gas and its arcing products shall be stable over the intervals between maintenance. The Supplier is required to identify the lubricants used and to submit details with the tender documentation (refer to subclause 3.2.13.2.2) of tests carried out to prove suitability for the application. If possible, a list of equivalent lubricants from South African sources shall be provided. All liquids or chemicals shall be supplied with Material Safety Data Sheets (MSDS).
- e) For all disconnector and earthing switch types, the Supplier shall give details with the tender documentation (refer to subclause 3.2.26.1) of the cement metallic flange design taken to prevent corrosion or cracking.
- f) The Supplier shall complete **Table C1** under **Annex C** with detailed Material and Corrosion Protection Information and this shall be submitted with the tender documentation. This shall be the information on each offered type design, disconnector and earthing switch.

3.2.15 Disconnector and earthing switch support structure and foundation

As per Eskom Transmission standard, the steel support structures and foundation shall be in accordance with subclause 3.2.25 and Annex D , **Table D2**.

- a) The following mechanical loads and parameters relating to the design of the disconnector and earthing switch support structure and foundation shall be stated in Schedule B and be shown on the general arrangement drawing (refer to subclause 3.2.26.1):
 - i. dead weight of the disconnector or earthing switch (N);
 - ii. the rated static mechanical terminal loads (forces) F_{a1} and F_{a2} F_{b1} and F_{c^a} (loads) of the disconnector or earthing switch (N) due to connected conductors;

**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**

Revision: **1**

Page: **41 of 91**

NOTE: Static mechanical terminal loads (forces) due to flexible and tubular conductors (not including wind, ice load or the dynamic loads on the disconnector or earthing switch itself) can be assumed to be in accordance with Table 4 of SANS 62271-102 subclause 5.104.

- iii. in case of offered divided support disconnectors (Eskom Transmission requirement for pantographs and (vertical) knee-type design) and divided support earthing switches (upon special requirements) - the rated values specified by the manufacturer of the contact zone (indicated by x_r , y_r and z_r of SANS 62271-102 subclause 5.103 preferred values as given in its Table 2 and Table 3,.
- x = total amplitude of longitudinal movement of the supporting conductor (temperature).
 - y = total horizontal deflection (perpendicular to supporting conductor) (wind).
 - z = vertical deflection (ice)

NOTE: The rated values shall be specified by the manufacturer

- iv. where applicable, horizontal force (load) exerted during operation on the foundation (N), vertical force (load) exerted during operation on the foundation (N), moment (torque) exerted during operation about the foundation (Nm);
- v. wind force (load) exerted on the disconnector or earthing switch due to a wind velocity of 34 m/s (N);
- vi. where applicable, maximum torque required for the foundation holding down bolt nuts used to secure the support structure column to foundation (Nm);
- vii. mounting and fastening arrangement for the disconnector or earthing switch support structure onto the foundation including the minimum required length of foundation holding down bolts; and
- viii. where applicable, centre of gravity of the disconnector or earthing switch.

3.2.15.1 The steel support shall be designed according to the following requirements (if part of the supply):

The following requirements shall be fulfilled (and the details on corrosion protection under subclause 3.2.14 and **Table C1** under **Annex C**):

- Steel shall be in accordance with SANS 1431
 - Steel shall be Grade 350W
 - Steel shall be hot-dip galvanised in accordance with SANS 121
 - Welding shall conform to the requirements of SANS 10044.
 - Welds shall be seal welded.
 - Steelwork shall be fabricated, erected and leveled to a tolerance of ± 1.5 mm.
 - Bolts and nuts shall be in accordance with SANS 1700:5.
 - Bolts and nuts shall be Grade 8.8.
 - Bolts, nuts and washers shall be hot-dip galvanised in accordance with SANS 121.
 - Holes shall have diameter of 18 mm for M16 bolts.
 - All works shall comply with the requirements of SANS 1200
- b) In case of disconnectors (conventional type, including knee-type and the common operating drive disconnectors (pantographs) and earthing switches, the common base frame (i.e. for a pole-beam support arrangement) and inter-phasing cross beams shall be supplied with the disconnector and earthing switch and designed to interface with the standard Eskom Transmission steel support structure and concrete foundation in accordance with the Application Guide (0.54/8829) or applicable drawings specified in Annex D , **Table D2**.

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Unless it is specified in Schedule A that the steel support structure and/or concrete foundation is to be designed by the manufacturer, the disconnecter and earthing switch shall be designed to interface with the standard Eskom Transmission steel support structure and/or concrete foundation in accordance with the Application Guide (0.54/8829) or applicable drawings specified in Annex D , **Table D2..**

3.2.16 Electro-Magnetic Compatibility (EMC)

Requirements concerning EMC of the equipment shall be according to Clause 5.18 of SANS 62271-102.

3.2.17 Requirements in respect of the isolating distance of disconnectors

For reasons of safety, disconnectors shall be designed in such a way that no dangerous leakage currents can pass from the terminals of one side to any of the terminals of the other side of the disconnector.

This safety requirement is met when any leakage current is led away to earth by a reliable earth Connection or when the insulation involved is effectively protected against pollution in service.

NOTE: it is usual that the isolating gap of a disconnector is longer than the phase-to-ground insulating distance since SANS 62271-1 specifies higher withstand test levels across the isolating distance than for the phase-to-ground insulation.

Where a long creepage distance is required, the phase-to-ground insulation distance should become longer than the isolating gap. For such cases, to maintain low probability of disruptive discharge across the isolating gap, the use of protective devices such as surge arresters or rod gaps may be necessary and shall be approved in writing by Eskom Transmission prior to acceptance.

3.2.18 Mechanical Strength

Disconnectors and earthing switches having a rated static mechanical terminal load when installed according to the manufacturer's instructions shall be able to withstand their rated static and dynamic mechanical terminal load without impairing their reliability or current carrying capacity.

Operation of Disconnectors and Earthing Switches – Position of the Movable Contact System and its Indicating and Signalling Devices

3.2.19 Securing of Position

Disconnectors and earthing switches, including their operating mechanisms, shall be designed in such a way that they cannot come out of their open or closed position by gravity, wind pressure, vibrations, reasonable shocks or accidental touching of the connecting rods of their operating system.

Disconnectors and earthing switches shall permit temporary mechanical locking in both the open and closed position for safety purposes (for example maintenance).

3.2.20 Additional Requirements for Power-operated Mechanisms

Motor operated mechanisms shall also be provided with a manual operating facility. Connecting a hand-operating device (for instance a hand crank) to the power-operated mechanism shall ensure safe interruption of the control energy to the power-operated mechanism.

3.2.21 Indication and Signalling of Position

The disconnector and earthing switch main contact position indication shall be clearly visible from ground level and from the disconnector and earthing operating mechanism enclosure when the front access door is opened.

The following symbols and colours shall be used for the position indication of the disconnector and earthing switch main contacts:

- disconnector or earthing switch Closed: "I" in white lettering on a red background
- disconnector or earthing switch Open: "O" in white lettering on a green background

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Lettering size shall be at least 30 mm, unless otherwise approved by Eskom.

Other indication for manual operating shall be displayed in black lettering on a white background. The lettering height shall be at least 15 mm. The use of symbols to indicate position condition will not be accepted.

Indication and signalling of the closed and open position shall not take place unless the movable contacts have reached their closed or open position, respectively, and the first paragraph of subclause 3.2.19 is fulfilled.

a) Indication of Position

It shall be possible to know the operating position of the disconnector or earthing switch. For the open position this requirement is met if one of the following conditions is fulfilled:

- i. The isolating distance or gap is visible;

The position of each movable contact ensuring the isolating distance or gap is indicated by:

- i. A reliable visual position indicating device.

The kinematic chain between the movable contacts and the position indicating device shall be designed with sufficient mechanical strength to meet the requirements of the specified tests. The position indicating kinematic chain shall be a continuous mechanical connection to ensure a positively driven operation. The position indicating device may be marked directly on a mechanical part of the power kinematic chain by suitable means. The strain-limiting device, if any, shall not be part of the position indicating kinematic chain.

Where all poles of a disconnector or earthing switch are mechanically coupled so as to be operable as a single unit, it is permissible to use a common position indicating device.

b) Electrical Position Signalling by Auxiliary Contacts

A common signal for all poles of a disconnector or earthing switch shall be given only if all poles of the disconnector or earthing switch have a position in accordance with subclause 3.2.21.

Where all poles of a disconnector or earthing switch are mechanically coupled so as to be operable as a single unit, it is permissible to use a common position indicating device.

All indicating devices shall be clearly visible and legible by persons with normal vision standing at ground level. In addition, it shall be possible to carry out all routine inspection activities from the ground level. Where applicable (GIS and MTS), details of any special equipment required to view all disconnectors and earthing switches status indications and make necessary inspections from the ground level, the Supplier shall submit this with the tender documentation for Eskom Transmission approval.

3.2.22 Maximum Force Required for Manual Operation of motor-operated disconnectors

The values given below shall apply to the manual operation of the motor-operated disconnectors (during manual operating). The operating force shall be in accordance with SANS 62271-102 subclause 6.105.

NOTE: these values include ice-breaking, if applicable.

In accordance with SANS 62271-102 subclause 10.2 d), the operating height above servicing level shall be agreed between manufacturer and Eskom Transmission .

3.2.22.1 Operation requiring more than one Revolution

The force needed to operate a disconnector or earthing switch requiring more than one revolution (hand crank for example i.e. manual operation) shall not be higher than 80 N with a possible peak of 120 N during a maximum of 90 % of the total required revolutions (refer to SANS 62271-102 subclause 6.105.2).

3.2.22.2 Operation Requiring up to one Revolution

The force needed to operate a disconnector or earthing switch requiring up to one revolution (swing lever for example i.e. manual operation) should not exceed 250 N (refer to SANS 62271-1 subclause 5.6.3) and a maximum value of 450 N during a rotation of 15° maximum shall be acceptable (refer to SANS 62271-102 subclause 6.105.3).

3.2.23 Dimensional Tolerances

For the mounting dimensions and the dimensions of high-voltage connections as well as the earthing connections of disconnectors and earthing switches, the tolerances given in ISO 2768-1 shall apply for linear and angular dimensions.

3.2.24 Working Clearances and Personnel Safety

The disconnector and earthing switch shall be installed in a manner that ensures safety to authorised personnel.

- a) Live parts shall be isolated by means of elevation.

NOTE: The use of protective fences to prevent contact with live parts is not acceptable.

- b) The electrical working clearance from ground to live parts at system voltage, the electrical clearance from ground to live parts at system voltage, which based on the minimum safety clearances as required by statutory requirements contained in the Occupational Health and Safety Act No. 85 of 1993, shall be complied with. Electrical working clearances are given in **Table 8**.

Table 8: Minimum electrical working clearances

<i>System voltage</i> [kV]	<i>Working clearance</i>	
	Working clearance (vertical) (C_{wv}) (mm)	Working clearance (horizontal) (C_{wh}) (mm)
	Supplier to comply as per NOTE	
22	2 800	1 400
33	2 930	1 500
44 and 66	3 270	1 800
88 and 132	3 950	2 300
220	4 300	2 900
275	4 850	3 400
400	5 700	4 300
765	10 200	(TBA upon project)
+/- 533 DC		(TBA upon project)

NOTE: The working clearance is calculated by summing the height of a person with his/her arm in an extended upward position (i.e. 1800 + 700 = 2 500 mm) and the minimum safety clearance as required by the Occupational Health and Safety Act No. 85 of 1993.

- c) The distance from the lowest part of any high-voltage (i.e. > 1000 V) insulation above ground shall not be less than 2 500 mm.
- d) Moving parts shall not pose any hazard to personnel or adjacent equipment. There shall be no shock hazards present to operating persons.
- e) For integral type earthing switches fitted to a disconnector where electrical clearance to live parts is reduced temporarily during operation it is a requirement that compliance with Annex D of SANS 62271-102 is demonstrated by means of suitable high voltage tests. Satisfactory proof of such tests in the form of type test certification shall be submitted with the tender documentation.

- f) In the case of disconnectors and earthing switches on the GIS or compact Mixed Technology Switchgear (MTS) also known as Hybrid Switchgear, the Pressure relief devices (PRD) shall be orientated so as not to pose any hazard to personnel or adjacent equipment. Details of pressure relief devices (PRD) offered shall be provided with the tender documentation, and shall be stated in Schedule B.

The requirements for internal faults (internal arc) and pressure relief devices (PRD) shall be in accordance with SANS 62271-203. The Supplier shall provide details with the tender documentation (refer to subclause 3.2.26.1) regarding the time during which an arc due to an internal fault up to a given value of short-circuit current will cause no external effects. The definition of this time shall be based on test results or an acknowledged calculation procedure. Refer to SANS 62271- 203 subclause D.1. The duration of current without burn-through for different values of the short-circuit current may be estimated from an acknowledged calculation procedure.

3.2.25 Drawings

3.2.25.1 Outline and General Arrangement

The Supplier shall prepare disconnector and earthing switches drawings in accordance with Annex D , **Table D2**. The steel support structure and/or concrete foundation shall be supplied by Eskom Transmission in accordance with Eskom Transmission standard drawings listed under **Annex D, Table D2**, and the disconnector and earthing switch shall interface with these. Where additional adaptors and plates are required by the disconnector or earthing switch design, those shall form part of the Supplier and manufacturer scope of supply. For pantograph disconnectors, this includes the main trapeze contact and its mounting accessories that clamps to the Eskom Transmission busbar conductor types tubular and flexible (Single, Twin and triple Bull).

- Where Eskom Transmission has indicated **Annex D , Table D2** and specified in schedule A the requirement for supply of steel support structures, then those shall be the Supplier's scope of supply and be designed by manufacturer, the disconnector and earthing switch shall be designed to interface with the standard Eskom Transmission civil foundations.

The Supplier and their OEM factory shall submit with the tender documentation (refer to subclause 3.2.26.1) the Outline General Arrangement (GA) drawings that include the following details:-

The minimum information on drawings shall include (also refer to subclause 3.2.26.1 b) and c)):

- a) Leading dimensions, i.e., phase to phase spacing, minimum phase to phase clearance, distance to main-terminals, electrical clearance (distance to nearest live portion above ground), distance above ground to top of operating mechanism, dimensions of mechanism, overall height, width and depth.
- b) Base frame mounting details and holding down bolts to interface with the steel support and civil foundation.
- c) Details of main terminals and earthing switch terminals;
- d) Maximum permissible loading on main terminals (with directions) expressed in Newtons;
- e) Mass of equipment in kilograms, which shall include the mass and description of the heaviest component. If necessary operating forces produced between the poles.
- f) Any special trenches or support steelwork required between phases;
- g) Where applicable, a dimensioned outline and general arrangement drawing including foundation details of the supporting structures offered, if not included in the above.
- h) Forces - operating forces and directions for all operations (dynamic and static).
- i) The centre of gravity
- j) Title to include nominal voltage, normal current rating and short-circuit withstand current and duration in the title blocks of the drawings.

- k) The outline and general arrangement of the post insulators with details [material type, classification, dimensions, creepage distance, withstand voltages (power frequency, switching and lightning), mechanical strength, shed profile, top and bottom PCDs].

3.2.26 Documentation requirements

3.2.26.1 The documentation to be submitted with tender documentation

The Supplier shall provide the following documentation with the tender documentation:

- a) completed technical schedule B for each offered disconnector and earthing type and size. The technical Schedule B shall not be left blank. Where numerical values (e.g. rated values, dimensions, etc.) or specific information is required, the actual value/information offered shall be stated. In such cases, use of the words "COMPLY", "TBA", "NOTED", etc. is not acceptable;
- b) A full set of general arrangement (GA) drawings (also refer to subclause 3.2.25 and **Annex D**) showing the following minimum information:
- ii. manufacturer's drawing number and revision number; Provision shall be made on each sheet for an Eskom-allocated drawing number as well as for the Eskom Transmission contract number – for population after awarding of the contract;
 - iii. critical dimensions such as overall dimensions, structure dimensions, phase to phase spacing, phase to phase and phase to earth air clearances, working clearance, height of lowest part of insulation above ground, height of top of mechanism enclosure shall allow for personnel to operate with manual operation handle from ground level and perform duties on ground level (indications, inspections), mechanism enclosure dimensions, overall height, width and depth of disconnector, etc.;
 - iv. details of post insulators [material type, classification, dimensions, creepage distance, withstand voltages (power frequency, switching and lightning), mechanical strength, shed profile, top and bottom PCDs];
 - v. properly annotated drawing with a complete list of major components (bill of materials);
 - vi. details of main terminals including dimensions of the fixing holes, terminal hole spacing, plate thickness and maximum permissible loading on main terminals (with directions) expressed in Newton (N);
 - vii. details of the main earthing terminal and mechanism enclosure earthing terminal;
 - viii. mass of complete disconnector or earthing switch in kilograms (kg), which shall include the mass and description of heaviest component, total mass of disconnector ready for service;
 - ix. any special trenches or steelwork required between phases;
 - x. for disconnectors used in systems with nominal voltages above 400 kV, the support structure dimensioned outline and general arrangement and holding down bolts details;
 - xi. for disconnectors used in systems with nominal voltages above 400 kV, the support structure earthing terminal;
 - xii. for disconnectors used in systems with nominal voltages above 400 kV, the support structure label mounting holes;
 - xiii. mounting and fastening arrangement for the disconnectors support structure onto the foundation including the minimum required length of foundation holding down bolts as well as the relative position of levelling nuts, spacers, washers, etc. in relation to the base plate;
 - xiv. maximum torque required for the foundation holding down bolt nuts used to secure the support structure base plate (Nm);
 - xv. dynamic horizontal force (N) exerted during operation on the foundation – vector showing location, magnitude and direction;

- xvi. dynamic vertical force (N) exerted during operation on the foundation – vector showing location, magnitude and direction;
- xvii. dynamic moment (Nm) exerted during operation about the foundation – showing location, magnitude and direction;
- xviii. relative location of disconnector poles, base-frame and operating mechanism enclosure(s);
- xix. location of all enclosure doors and handles;
- xx. location and annotation of control facilities;
- xxi. location and layout of LV control cable gland plates; and
- xxii. location of nameplate on disconnector;
- xxiii. details about the bus transfer device;
- xxiv. layout of terminal strips;
- c) for all external insulation (i.e. post-insulators offered), detailed outline and general arrangement drawings showing the shed profile dimensions including shed and insulation body/core diameters, shed spacing, creepage distance and dry arcing distances, etc. This shall have manufacturer's drawing number and revision number. Provision shall be made on each sheet for an Eskom-allocated drawing number as well as for the Eskom Transmission contract number – for population after awarding of the contract;
- d) drawings showing the generic layout of all the nameplates (disconnecter, earthing switch, operating device(s)) in accordance with subclause 3.2.25 and 3.2.26.1. Provision shall be made for an Eskom-allocated drawing number as well as for the Eskom Transmission contract number - for population after awarding of the contract;
 - i. Information about rating plate fixing (refer to subclause 3.2.9 a));
- e) generic auxiliary and control circuit schematic wiring diagrams for the disconnector and earthing switch. Provision shall be made for an Eskom Transmission allocated drawing number as well as for the Eskom Transmission contract number - for population after awarding of the contract;
- f) a general arrangement drawing of the operating mechanism enclosure. This shall have manufacturer's drawing number and revision number. Provision shall be made for an Eskom-allocated drawing number as well as for the Eskom Transmission contract number - for population after awarding of the contract;
- g) full list of spares required for maintenance (refer to subclause 3.5.4 e));
- h) spares availability philosophy (refer to subclause 3.5.4.2);
- i) full list of operating tools (refer to 3.5.3 f))
- j) detailed list of standard tools required for minor maintenance (refer to subclauses 3.5.3 f) and 3.6.2);
- k) detailed list of additional specialised tools for major (specialised) maintenance (refer to subclause 3.5.1 f) and 3.6.2);
- l) full list as well as copies of type test reports and/ or certificates as specified in the standard specification (refer to subclause 3.3.1.2 a))
- m) generic routine test certificates for the disconnectors (refer to subclause 3.3.1.2 b));
- n) transport, storage, installation, operation and maintenance instruction manuals (refer to subclause 3.6);
- o) training material and courses (refer to subclause 3.7 and Annex E);
- p) Generic quality Inspection and Test Plans (ITP's), and impact recorders;
- q) the submission, where applicable, of the following additional information:

- i. premature failures experienced in service of similar design disconnectors and earthing switches supplied elsewhere by the manufacturer, together with the recommended modifications (refer to subclause 3.2.3.1e));
- ii. where applicable (for GIS or MTS), details of any special equipment required to view all disconnectors and earthing switches status indications and make necessary inspections from the ground level (refer to subclause 3.2.21b));
- iii. details of corrosion protection and the list of offered lubricants (greases) as per this standard specification subclause 3.2.14.);
- iv. information about bushes and method of lubrication (refer to subclause 3.2.7.3).
- v. measures taken to prevent cement flange corrosion (refer to subclause 3.2.14 e));
- i. where applicable (for GIS and MTS), details of the internal arc behaviour of the disconnector and earthing switch (refer to subclause 3.2.24 f))
- ii. quality control plans and inspection test plans (QITP) indicating all inspection hold points (refer to subclause 3.2.26.1 p));
- iii. details of equipment requiring maintenance during storage (refer to subclause 3.4.6.1 a));
- iv. copy of the storage and handling procedures which indicate the maximum recommended period of storage (refer to subclause 3.4.6.1 b));
- v. a written commitment from the Supplier regarding the submission of the maintenance digital Video record (portable format e.g. USB memory stick or DVD) (refer to subclause 3.5.2);

All the documentation required in this standard specification and Schedule A shall be submitted by the Supplier with its OEM factory with the tender documentation. This includes the following, but not limited to:-

- Method used to achieve immunity from spurious operation due to induced surges in the control cables is subject to approval by Eskom.
- Provide the details of the specified training by the OEM accredited trainers as per this Eskom Transmission Standard Specification: Switchgear training from original equipment manufacturers.

3.2.26.2 Documents to be supplied upon awarding or contract

The Supplier shall submit the following documentation to the contract manager and relevant Eskom Transmission technical switchgear specialist upon awarding of a contract:

- a) detailed switchgear drawings for Eskom Transmission commenting and approval signing off (speedily submit);
- b) switchgear equipment training material that is being developed for Eskom Transmission commenting and approval;
- c) quality inspection and test plan (QITP) in accordance with Eskom Transmission quality requirements documentation (i.e. factory QITP and site QITP).
- d) in case this was not available during tender stage, submit the disconnector capability on continuous or temporary overload due to changed service conditions (refer to subclause 3.3.2.1.3);
- e) Operation and Maintenance Instruction Manual for Eskom Transmission to ensure the contents as this standard specification is addressed;
- f) maintenance digital Video record (portable format e.g. USB memory stick or DVD) for Eskom Transmission commenting and approval;
- g) for the operator level a basic inspection checklist detailing minor inspection requirements;
- h) routine checks and maintenance actions of a minor and major nature required in order to ensure correct operation of the equipment;
- i) for each type of prescribed maintenance intervention detailed scope of works (job plan), detailed work instructions (task manual) and detailed works reports (check sheet).

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3.2.26.3 The documentation to be delivered with each disconnecter or earthing switch

Unless otherwise specified in Schedule A, the manufacturer shall submit the following documentation with each disconnecter and earthing switch delivered to Eskom:

- a) an auxiliary and control circuit schematic wiring diagram of the disconnecter and earthing switch;
- b) a complete set of routine test certificates;
- c) a commissioning and hand-over test sheet; and
- d) one set of transport, storage, installation, operation and maintenance instruction manuals.

NOTE: In addition to the documents supplied with the disconnecter and earthing switch, all documents shall be made available in electronic format for publication on the Eskom Transmission internal equipment database.

3.2.26.4 Storage of supplied documents

The above documents supplied with the disconnecter and earthing switch shall be stored in the documentation pocket on the inside of the disconnecter and earthing switch operating mechanism enclosure front access door.

NOTE: In addition to the documents supplied with the disconnecter and earthing switch, all documents shall be made available in electronic format for publication on the Eskom Transmission internal equipment database.

3.3 Tests

3.3.1 General

- a) Manufacturer's testing capabilities

The manufacturer shall be fully responsible for performing or having performed all the required tests as specified. Suppliers shall confirm the manufacturer's capabilities in this regard when submitting tender documentation. Any limitations shall be clearly stated. The Supplier shall be responsible for all costs related to testing.

3.3.1.1 Witnessing of tests

Eskom Transmission reserves the right to be present at the OEM factory manufacturing and testing facilities for any of the tests specified for the disconnectors and earthing switches, this includes the FAT witnessing of the first disconnecter or earthing switch manufactured according to the Eskom Transmission standard specification. The Supplier shall ascertain the sequence of tests required in each particular case and whether witnessing of tests is required, and, after completion of all preliminary tests, shall then give Eskom Transmission sufficient, agreed upon, advanced notice of the firm date when the disconnecter or earthing switch and its associated apparatus will be ready for the witnessing of testing. The electronic online condition monitoring and/or integrated diagnostic devices shall form part of the testing.

NOTE: Where applicable, the minimum required notification period for overseas travel from South Africa is 12 weeks.

Eskom Transmission shall be notified as soon as possible of all test failures and corrective measures. This shall take the form of abbreviated reports that shall, upon request, be supported by more detailed reports. It is desirable that Eskom Transmission is notified of test failures to allow in situ inspection if desired.

3.3.1.2 Test certificates and reports

- a) Type test reports and/or certificates together with each complete summary of type test (in English) shall be supplied with the tender documentation (refer to subclause 3.2.26.1). The type test reports and/or certificates and the summary of type tests shall be in both printed copy and in electronic Portable Document Format (PDF). The type test reports shall be in electronic Portable Document Format (PDF).

- i. The type test certificate which is the proof of official accreditation shall have the official signatures of the accredited test laboratory where the type-tests were performed which is responsible for its validity and contents. The type test certificate shall contain a record of series of type-tests carried out strictly in accordance with the IEC standard. It shall contain essential drawings and the equipment tested.
- ii. Where the Supplier and OEM are using the type test certificate and type test report beyond that particular equipment that was type tested, to indicate that the other equipment types with their different ratings are covered by the type test certificate and type test report, a separate official signed-off letter on the company's letterhead shall be supplied by the Supplier with the tender documentation. This letter shall clearly state all particular tests and the tested parameters that are extrapolated from the type test certificate and type test report.
- iii. The summary list of type-tests indicating the following:-
 - o The type test performed,
 - o The IEC standard it was type tested on,
 - o The type test report document number;
 - o The date of type test performed
 - o The Test Facility where the type test was performed, the Test facility accreditation authority.
- b) Generic routine test certificates/reports shall be supplied with the tender documentation (refer to subclause 3.2.26.1) in electronic format (pdf). The test certificate shall indicate (make provision for) the tests performed, results, identification of the equipment tested, etc. The format of the test certificate/report shall make provision for approval by an authorised Eskom Transmission representative.
- c) One hardcopy of the routine test certificates/reports shall be supplied with each disconnector or earth switch and stored in the documentation pocket inside the operating mechanism enclosure. In addition to the hardcopy, the routine test certificates/reports shall be made available in electronic format and submitted to Eskom Transmission.

3.3.2 Type and routine test requirements

3.3.2.1 Type tests

- a) The manufacturer shall perform a complete set of type tests for each disconnector and earthing switch design offered. It shall be noted that as a minimum the disconnector and earthing switch offered shall have passed the list of type tests in accordance with SANS 62271-102 that are marked under Table 13 as Mandatory type tests, without which the offered disconnector and earthing switch shall not be taken to further consideration by Eskom Transmission.

The type test certificates and reports shall be submitted for review during the tender or product evaluation stage, as a minimum single copies shall be submitted. The type test reports shall be according to SANS 62271-102. The information included in the type test reports shall be in accordance with SANS 62271-1 subclause 7.1.3 and additions as per SANS 62271-102 subclause 7.1.3.

All type test done on IEC 60129 shall not be accepted. If any type testing is carried out during awarded contract period, Eskom Transmission shall be invited as a witness.

NOTE: If, in the opinion of Eskom Transmission, repeat or new type-tests are necessary, the cost of these tests will be taken into account in the evaluation of tenders. In such a case, Eskom Transmission may request the Supplier to submit details of the cost of carrying out each applicable type test.

- b) **Mandatory type tests**
 - i. The disconnector shall be type tested in accordance with SANS 62271-102 and shall include the following tests:
 - Dielectric tests (SANS 62271-102 subclause 7.2);

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**

Revision: **1**

Page: **51 of 91**

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- this shall include these applicable tests - Power-frequency voltage tests (PFWL) (SANS 62271-1 subclause 7.2.7.2 and 7.2.8.2); Lightning Impulse voltage tests (BIL or LIWL) (SANS 62271-1 subclause 7.2.7.3 and 7.2.8.4); Switching Impulse voltage tests (SIWL) ($U_r > 245$ kV) (SANS 62271-1 subclause 7.2.8.3); Artificial pollution tests for outdoor insulators (SANS 62271-102 subclause 7.2.9); Partial discharge tests (SANS 62271-102 subclause 7.2.10); Dielectric tests on auxiliary and control circuits (SANS 62271-102 subclause 7.2.11);
- Measurement of the resistance of the main circuit (SANS 62271-102 subclause 7.4.4);
 - Continuous current tests (SANS 62271-102 subclause 7.5);
 - Short-time withstand current and peak withstand current tests (SANS 62271-102 subclause 7.6);
 - Mechanical endurance tests (SANS 62271-102 subclause 7.102.3).
- ii. The earthing switch shall be type tested in accordance with SANS 62271-102 and shall include the following tests:
- Dielectric tests (SANS 62271-102 subclause 7.2);
 - Short-time withstand current and peak withstand current tests (SANS 62271-102 subclause 7.6);
 - Mechanical endurance tests (SANS 62271-102 subclause 7.102.3).
- c) Further list of type tests, applicable to disconnecter and earthing switch in accordance with Eskom Transmission specified requirement:-
- i. The disconnecter and earthing switch shall be type tested in accordance with SANS 62271-102 and shall include the following tests:
- Verification of the degree of protection (Assigned IP- and/or IK-code) (SANS 62271-102 subclause 7.7);
 - Radio interference voltage (RIV) test ($U_r \geq 245$ kV) (SANS 62271-102 subclause 7.3);
 - EMC tests (Presence of electronic components) (SANS 62271-102 subclause 7.9);
 - Additional tests on auxiliary and control circuits (SANS 62271-102 subclause 7.10); this shall include these applicable tests - Measurement of the resistance of auxiliary contacts (SANS 62271-1 subclause 7.4)
 - Contact zone test (Divided support i.e. Eskom Transmission requirement for pantographs and (vertical) knee-type design and upon special requirement the earthing switches) (SANS 62271-102 subclause 7.102.2);
 - Operation during application of rated static mechanical terminal load (SANS 62271-102 subclause 7.102.4);
 - Extended mechanical endurance tests (Class M1 or M2) (SANS 62271-102 subclause 7.102.5);
 - Testing on mechanical interlocking devices (Presence of interlock blocking the operating shaft or power kinematic chain) (SANS 62271-102 subclause 7.102.6);
 - Operation under severe ice conditions (for 10 mm and above) (SANS 62271-102 subclause 7.103);
 - Low and high temperature tests (If maximum ambient temperature $> +40^\circ\text{C}$ or minimum ambient temperature $< -5^\circ\text{C}$) (SANS 62271-102 subclause 7.104);
 - Tests to verify the proper functioning of the position-indicating device (Presence of position indicating device) (SANS 62271-102 subclause 7.105);
 - Tightness tests, where applicable (Controlled, sealed or closed pressure systems) (SANS 62271-102 subclause 7.8);

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- X- ray radiation test, where applicable (Presence of vacuum interrupters) (SANS 62271-102 subclause 7.11);
 - cantilever load withstand test (SANS60137 subclause 8.9) (for bushings on compact MTS (also known as Hybrid design) manufactured in accordance with SANS 62271-203);
 - additional tests on auxiliary and control circuits (SANS 62271-100 subclause 6.10);
 - proof tests for enclosures (compartment/ metallic tank) (for GIS and compact MTS (also known as Hybrid design)) (SANS 62271-203 subclause 6.103);
 - internal pressure test on gas-filled, gas-insulated and gas-impregnated bushings (SANS 60137 subclause 8.11) (for GIS and compact MTS (also known as Hybrid design)) manufactured in accordance with SANS 62271-203);
 - test under conditions of arcing due to an internal fault (for GIS and compact MTS (also known as Hybrid design)) (SANS 62271-203 subclause 6.105);
 - insulator tests (for GIS and compact MTS (also known as Hybrid design)) (SANS 62271-203 subclause 6.106); and
 - corrosion test on earthing connections (for GIS and compact MTS (also known as Hybrid design)) (SANS 62271-203 subclause 6.107).
- ii. The following type tests that are applicable to disconnecter only, in accordance with SANS 62271-102:
- Bus-transfer current switching tests (Applicable to disconnectors of $U_r > 52$ kV) (SANS 62271-102 subclause 7.106);
 - Bus-charging current switching tests, where applicable (SANS 62271-102 subclause 7.108);

NOTES

- a) Applicable to disconnectors of $U_r > 52$ kV forming part of GIS or compact Mixed Technology Switchgear (MTS) also known as Hybrid Switchgear. For $U_r < 300$ kV, tests are generally considered not necessary and are subject to agreement between user (Eskom Transmission) and manufacturer.
- b) As per NOTE on SANS 62271-102 subclause 110: Bus-charging switching capability for air-insulated disconnectors is subject to agreement between the manufacturer and the user, refer to IEC/TR 62271-305
- iii. The following type tests that are applicable to earthing switch only, in accordance with SANS 62271-102:
- Test to prove the short-circuit making performance of earthing switches (Class E1 or E2) (SANS 62271-102 subclause 7.101);
 - Induced current switching tests (Class A or B) (SANS 62271-102 subclause 7.107);

3.3.2.1.2 Routine tests

The routine test reports shall be submitted for review during the tender or product evaluation stage, as a minimum single copies shall be submitted. The routine test reports shall be in accordance with SANS 62271-102. All type test done on IEC 60129 shall not be accepted.

Routine test reports approved by Eskom Transmission shall be submitted with despatch of each equipment item from the OEM's factory works and included in all manuals. Test reports shall be in English.

- d) The disconnecter and earthing switch shall be routine tested in accordance with SANS 62271-102 subclause 8 and SANS 62271-1 subclause 8, and shall include the following tests:
- dielectric test on the main circuit (SANS 62271-102 subclause 8.2);
 - tests on auxiliary and control circuits (SANS 62271-102 subclause 8.3);

NOTE: In the case of switchgear supplied from an overseas OEM where the wiring of auxiliary and control circuits is done locally, the tests on auxiliary and control circuits are to be done locally as part of the local factory acceptance testing (FAT).

- Measurement of the resistance of the main circuit (applicable to disconnecter) (SANS 62271-102 subclause 8.4);
- Tightness tests, where applicable (Controlled, sealed or closed pressure systems) (SANS 62271-102 subclause 8.5);
- design and visual checks (in accordance with SANS 62271-102 subclause 8.6);
this shall include these applicable tests/ checks –
 - thickness of coating (including galvanise);
 - contact pressure measurement;
 - Operating force measurement for manual type drives (in mechanical units);
 - Operating forces measurements of motor drives (in electrical and mechanical units).
- mechanical operating tests (in accordance with SANS 62271-102 subclause 8.101);
this shall include these applicable tests:-
 - minimum supply voltage and/or pressure (if any): 5 operating cycles;
 - minimum supply voltage and/or pressure (if any): 5 operating cycles;
 - disconnecter and earthing switch operated manually: 5 manual operating cycles.
- verification of earthing function (in accordance with SANS 62271-102 subclause 8.102);
this shall include these earthing switch applicable tests:-
 - test of electrical continuity;
 - contact resistance measurement;
 - contact pressure measurement;
 - visual inspection;
 - dimension check.

Additional routine tests applicable to the disconnecter and earthing switch manufactured in accordance with SANS 62271-203:-

- dry power frequency withstand voltage tests for bushings (SANS 60137 subclauses 8 & 9.3) (for GIS and compact MTS (also known as Hybrid design) manufactured in accordance with SANS 62271-203);
- partial discharge measurement (SANS 60137 subclauses 8 & 9.4) (for GIS and compact MTS (also known as Hybrid design) manufactured in accordance with SANS 62271-203);
- measurement of dielectric dissipation factor ($\tan \delta$) and capacitance at ambient temperature (SANS 60137 subclauses 8 & 9.1) (for GIS and compact MTS (also known as Hybrid design) manufactured in accordance with SANS 62271-203);

Where the Supplier and their OEM factory have agreed to perform some of the above routine tests, it shall be communicated officially to Eskom Transmission and the relevant ITP shall indicate this detail. In this case the Site testing shall be concluded with the formal Routine Test Report handed over to Eskom Transmission for every delivered disconnecter and earthing switch. If this report is intended also to be the Site Test Report, it shall be clearly identified with the dual naming of the intended outcome, and the relevant signing-off.

3.3.2.1.3 Continuous or temporary overload due to changed service conditions

In accordance with SANS 62271-102 subclause 9.4, the Eskom Transmission specified disconnectors could be required to carry a load current above its rated continuous current during a short period of time or when ambient temperatures are favourable to do it provided the temperature does not exceed the maximum temperature value specified in SANS 62271-102 Table 14; reference is made to IEC TR 62271-306 subclause 5.2.

The Supplier shall provide these details from their manufacturer factory about the offered disconnector design and submit to Eskom Transmission, preferably with the tender documentation (refer to subclause 3.1.4 g) and h)). In case of successful contract award, the Supplier shall provide this detail during design reviews at factory and factory acceptance testing (FAT) of the first delivered Eskom Transmission specified disconnector.

3.3.3 Tests after installation on site (pre-commissioning tests)

As per QITP, all the site pre-commissioning tests shall be an inspection hold points for witnessing by Eskom Transmission technical personnel. The following tests/inspections shall be performed upon completion of erection and prior to handing over of the equipment:-

- a) Measurement of the resistance of the main circuit (the main current carrying path – from terminal to terminal and each joint).
For the measurement of the steady-state contact resistance of the main circuit, a d.c. current of at least 100 A shall be used.
- b) Contact travel, end position and alignment (including bus transfer devices, where applicable).
- c) Complete operational check, including auxiliary switch function. (5 Open and 5 Close operations or operating cycles).
- d) Operating force measurement for manual type drives (in mechanical units).
- e) Operating forces measurements of motor drives (in electrical and mechanical units).
- f) Disconnector closing time (s) and opening time (s) (motor driven types only).
- g) Motor current measurement (motor driven types only)

NOTE: The measured times for nominal and minimum control voltage should be within $\pm 5\%$ of the times, as specified on the disconnector and earthing switch pass sheet supplied by the OEM factory.

Reasons for differences between the results of the tests made on-site and the results of the tests as they were carried out at the OEM's factory works (the disconnector and earthing switch pass sheet) shall be clearly stated and corrections shall be made.

The above shall be recorded accordingly and results of pre-commissioning tests after installation on site shall be documented. The Supplier shall issue Eskom Transmission with a standard Site Pre-commissioning Test Report that has the company official letterhead, which is signed off by the Supplier technical personnel who performed the installation and tests or their appointed accredited representative.

The signed off site pre-commissioning test report shall be included with the switchgear documentation for hand-over as part of the quality process. For further details on the pre-commissioning test report (refer to subclause 3.4.8.2.1).

3.4 Design reviews, Manufacturing, Transport, Storage, Installation, pre-Commissioning and After-sales Technical Support

3.4.1 Design Reviews inspection (factory visit) and factory Acceptance testing (FAT)

- a) Eskom Transmission reserves the right to perform Design Reviews inspect assessment with the potential Supplier that Eskom Transmission selects on the procurement process, before start of manufacturing and testing of the Eskom Transmission specified disconnector and earthing switch.

NOTE: Where applicable, the minimum required notification period for overseas travel from South Africa is 12 weeks, preferably few days after the Supplier has been selected by Eskom Transmission.

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Unless otherwise agreed by Eskom, in the case of Design Reviews at the factory of disconnector and earthing switch for use on systems with nominal voltages up to and including 765 kV, the erection of a completely functional prototype at the factory premises under direct supervision of the OEM for a comprehensive inspection by Eskom Transmission, which is well before erecting on site.

- b) The Design Reviews shall be performed by Eskom Transmission with the Supplier and at the OEM manufacturing and testing facilities relating to the disconnector and earthing switch type design offered. Amongst other points of reviewing the offered design, it shall entail a thorough confirmation to ensure complete compliance with this Eskom Transmission standard specification and Technical Schedules A & B, and the approved manufacturer's drawings with the Eskom Transmission standard interface drawings.
- c) Eskom Transmission reserves the right to inspect any ordered disconnector and earthing switch before shipment, or at any stage of manufacture and testing. This inspection, including Factory Acceptance Testing (FAT) of the first of manufactured Eskom Transmission disconnector and earthing switch, shall entail inspection checks to ensure complete compliance with this Eskom Transmission standard specification and Technical Schedules A & B, and the approved manufacturer's drawings with the Eskom Transmission standard interface drawings.

3.4.2 General

The manufacturing, transport, storage, installation and pre-commissioning of switchgear and controlgear, as well as their operation and maintenance in service, shall be carried out in accordance with the instructions given by the OEM. This shall meet the Eskom Transmission quality requirements.

The Supplier shall provide instructions for the transport, storage, installation, operation and maintenance of the equipment according to the requirements set out by the OEM (refer to subclause 3.2.26.1).

Eskom Transmission will only accept delivery to the destination specified and the Supplier shall make all necessary arrangements for acceptance, transportation and off-loading at the most convenient point, as well as for offloading at the ultimate destination (point of installation) and storage.

3.4.3 Inspection of manufacturing facilities and disconnector and/ earthing earthing switch

- a) Eskom Transmission reserves the right to perform design review inspect assessment at the OEM manufacturing and testing facilities relating to the disconnector and earthing switch type design offered - both before and at any time during manufacturing and testing.
- b) Eskom Transmission reserves the right to inspect any ordered disconnector and earthing switch before shipment, or at any stage of manufacture and testing. This inspection, including Factory Acceptance Testing (FAT) of the first of manufactured Eskom Transmission disconnector and earthing switch, shall entail a thorough check to ensure complete compliance with this Eskom Transmission standard specification and Technical Schedules A & B, and the approved manufacturer's drawings with the Eskom Transmission standard interface drawings.
- c) With the tender documentation, the Supplier shall submit the quality control plans and quality plans and quality inspection test plan (QITP) to Eskom Transmission, indicating all inspection hold points. Eskom Transmission may add the necessary inspection hold and/or witness points for Eskom Transmission or its appointed representative (refer to subclause 3.2.26.1 p)). The Supplier shall make due allowance for these activities in the manufacturing programme and, to avoid delays, shall give sufficient, agreed upon, advanced notice of the date of inspection. Eskom Transmission will not accept late delivery on the basis of inspection delays.

NOTE: Where applicable, the minimum required notification period for overseas travel from South Africa is 12 weeks.

- d) Any deviations in the disconnector and earthing switch design shall be pointed out in accordance with the tendered deviation schedule and the type test certificates provided for the specific unit design. No clearance will be given where there is no satisfactory evidence of the relevant type test certificates, where such tests are required.

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- e) Clearance shall be obtained before dispatching the equipment. This clearance shall be confirmed on the routine test certificates. No clearance shall be given where there are any outstanding defects resulting from Factory Acceptance Testing (FAT) or from this inspection.

3.4.4 Conditions during transportation

For the requirements on transportation, handling, storage and preservation the Supplier shall refer to the Eskom Transmission standard (240-53902499) and this standard specification subclauses 3.4.6 and 3.5.4.4.

- a) Conditions can be expected to be onerous during transport, storage and installation. Adequate precautionary measures shall be provided for the packaging and protection of sensitive components such as insulating parts and operating mechanisms during transport, storage and installation (including corrosion of exposed parts).
- b) Vibrations and impacts recording during transport shall also be mounted. Eskom Transmission requirement for packaging is non-resettable impact recorders (refer to subclause 3.4.5c).
- c) The Supplier shall demonstrate - either by testing or through previous satisfactory experience - that the equipment complies in this respect. Testing may include the following:
- shipping test: this test shall cover all the conditions to be encountered during transportation from factory to the designated site, including loading/off-loading from one mode of transport to another;
 - vibration test: this test may be used to supplement actual shipping tests to check for unexpected shortcomings in the equipment and packaging; and
 - weather-proof test: this test may demonstrate the adequacy of the packaging to prevent ingress of moisture and water from weather or sea conditions.
- d) If the design of the equipment is mature, and the equipment has previously been shipped under similar conditions, the above tests may be waived at Eskom Transmission's discretion.

3.4.5 Transportation and off-loading

For the requirements on transportation, handling, storage and preservation the Supplier shall refer to the Eskom Transmission standard (240-53902499).

- a) Refer to subclause 3.4.6 for the requirements for packaging for transportation and storage.
- b) The Supplier shall be responsible for the transportation and off-loading of the equipment on site. Off-loading includes transportation from the point of off-loading the equipment after transportation to the point of installation.
- c) The Supplier shall provide his/her own means of off-loading at the point of installation. The non-resettable impact recorders (gauges) shall be inspected by the Supplier if they operated due to the impact or shock and further initiate to investigate the extent of the damaged this caused.
- d) Eskom Transmission shall conduct an inspection on the first off equipment delivered to ensure and review compliance to Eskom Transmission. The Eskom Transmission representatives shall also review and modify if required the Inspection and Test Plans for the Transportation, Off-loading and Storage requirements of the product.

3.4.6 Packaging, storage and preservation requirements

For the requirements on packaging, storage and preservation the Supplier shall refer to this section, Eskom Transmission Quality requirements documentation as well as the Eskom Transmission standard (240-53902499).

**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**

Revision: **1**

Page: **57 of 91**

- a) The OEM will be required to demonstrate if there are different packaging currently implemented for existing customers and Eskom Transmission requirements. Each disconnecter or earthing switch shall be “unit-packed” (one unit per package). In other words, the components making up a complete disconnecter or earthing switch shall be delivered to site in one or more packing containers which shall contain only the component for one complete individual disconnecter or earthing switch.

NOTE: Eskom Transmission will not accept equipment if the various components of the different disconnectors or earthing-switches are delivered in the same packing containers.

- b) All disconnecter or earthing switch components shall be packed in containers (e.g. wooden crates) that are suitable for transport and storage over long periods (for up to 18 months). On how to handle preservation according to Eskom Transmission requirement refer to details below and Quality documentation.
- c) Durable waterproof packaging shall prevent damage to the disconnecter or earthing switch components during transportation and storage on site and shall be such that suitable ventilation is allowed in order to minimise condensation.
- d) The packaging shall be able to withstand impact loadings of at least 18 kN. The mechanical strength of the packaging shall not be dependent on the strength of the top cover, i.e. it shall be possible to remove and subsequently replace the top cover without losing any mechanical strength of the packaging.
- e) Where more than one crate is used per disconnecter or earthing switch, each crate shall be clearly and sequentially marked in order to identify each crate as belonging to a specific disconnecter or earthing switch (e.g. “CRATE 1 of 3”, “CRATE 2 of 3”, etc.).
- f) Eskom Transmission will review the markings that are currently being implemented on the packaging for safe handling of the product. Preservation markings, instructions will be required on the packaging and the necessary provisions provided for storage conditions. Each container/crate shall be clearly marked with a durable label using an indelible font at least 30 mm high indicating the following information:
- Eskom Transmission order number;
 - Eskom Transmission SAP number;
 - short disconnecter or earthing switch description (including the rated voltage, normal current, rated short-circuit breaking current, auxiliary d.c. control voltage; specific creepage, phase spacing);
 - manufacturer’s name (i.e. make of disconnecter or earthing switch);
 - manufacturer’s disconnecter or earthing switch product designation/code (i.e. type disconnecter or earthing switch);
 - manufacturer’s serial number(s);
 - contents of the crate (i.e. a parts list);
 - the crate number (e.g. “CRATE 1 of 2”, “CRATE 2 of 2”);
 - the crate overall dimensions (in mm); and
 - total mass of each crate (e.g. “TOTAL MASS: 1000 KG”);
 - pictograms / symbols showing correct storage and stacking instructions for crates
- g) Exposed shafts, bearings and machined surfaces shall be treated with a temporary anti-corrosive coating.
- h) Loose components or components that are subject to damage from exposure to dust or water shall be packed in hermetically sealed plastic bags.
- i) All components shall be clearly marked. Components that are physically impossible to mark shall be individually packed and the packaging shall be marked.

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- j) Fork-lift lifting points shall be provided on the packaging, where applicable. These points shall be braced as though it were a lifting pallet (for mechanical support during lifting activities).
- k) Where applicable, a readily accessible (i.e. without the need to remove / disturb the external packaging) external temporary 230 V a.c. supply connection point for the heater circuit during storage shall be provided and wired to the Eskom Transmission side of the terminal strip in the factory. This shall consist of an electrical cord wired to a screw-type connection block for the connection of the temporary a.c. supply used during storage. Heater connections shall be designed in such a manner so as not to cause a hazardous situation when energised. No internal wiring should need be modified to remove the temporary supply leads. The connection point shall be labelled “230 V AC HEATER CONNECTION: CONNECT IF STORED > 2 DAYS” or similar.

Where anti-condensation heaters need to be energised, a clearly marked electrical connection point shall be provided to enable Eskom Transmission to supply power to the heaters.
- l) A non-resettable impact recorder/ detector shall be provided and located in such a position so as to record/detect the acceleration of the disconnect or earthing switch body and not the packaging.
- m) Where applicable (for GIS and MTS), the disconnect or earthing switch shall be transported with a positive gas pressure of maximum 150 kPa.
- n) A copy of the BOM shall be provided with the delivery note for each disconnect or earthing switch supplied in order to allow the recipient to confirm that all items on the BOM have been delivered, and for record purposes.

Eskom Transmission shall conduct an inspection on the first off equipment delivered to ensure and review compliance to Eskom Transmission. The Eskom Transmission representatives shall also review and modify if required the Inspection and Test Plans for the Transportation, Off-loading and Storage requirements of the product.

3.4.6.1 Storage and preservation

- a) The Supplier shall provide the storage and preservation protocol from the OEM at tendering stage for Eskom Transmission evaluation, namely site requirements, spares requirement and stores facility requirement.
- b) The Supplier shall implement proper storage and handling (de-stuffing) procedures, which should always be part of site delivery documentation. A copy of the storage and handling procedures shall be made available to Eskom Transmission for acceptance. This shall indicate the maximum recommended period of storage (refer to subclause 3.4.6.1), as well as recommended actions to be taken if a longer storage period (preservation) is required.
- c) If any equipment requires maintenance or attention during storage, this shall be clearly stated in the contract and Eskom Transmission's attention shall be drawn to this fact. This information shall be submitted with the tender documentation (refer to subclause 3.2.26.1) as well as with orders upon awarding of a contract.
- d) At the time of off-loading at an Eskom Transmission facility, the Supplier has the responsibility to ensure that the necessary steps are taken by Eskom Transmission to ensure satisfactory storage.

3.4.7 Installation

- a) Unless otherwise specified and agreed (e.g. where OEM certified training and/or supervision is provided), the Supplier shall be responsible for the installation and pre-commissioning of the equipment. This includes the supply of all installation tools, lifting tackle and test equipment.

NOTE: for voltages up to 400 kV (also 550 kV rating), Eskom Transmission shall provide the standard steel support structures under a separate internal contract/order (unless otherwise specified). The details of the Eskom Transmission standard steel support structures shall be shared with the successful Supplier, to confirm this will be adequate for their equipment design and ensure that their equipment interfacing connection points fit, and in case of modifications needed then the Supplier and OEM factory makes provision for the recommended adaptors on their scope of supply.

**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**

Revision: **1**

Page: **59 of 91**

- b) Installation includes mounting and securing the equipment and its support structure onto the concrete support foundation, levelling of the switchgear, filling of gas (other insulation and/or arc-extinguishing medium), where applicable.
- c) For each type of disconnecter and earthing switch, the installation instructions provided by the Supplier (refer to subclause 3.2.26.1) according to the OEM's instructions shall at least include the items listed below:
- unpacking and lifting instructions: all information required for unpacking and lifting safely shall be given, including details of any special lifting and positioning devices that are necessary;
 - assembly: when the switchgear is not fully assembled for transport, all transport units shall be clearly marked. Drawings showing the assembly of these parts shall be provided with the switchgear;
 - mounting: instructions for mounting the common base frame, poles, operating device(s) and auxiliary equipment shall include sufficient details to enable site preparation to be completed. These instructions shall also indicate:
 - i. the total mass of the equipment, inclusive of insulation and/or arc-extinguishing medium, where applicable;
 - ii. the mass of insulation and/or arc-extinguishing medium, where applicable; and
 - iii. the mass of the heaviest part of the apparatus to be lifted separately if it exceeds 100 kg;
 - iv. The length of thread protrusion on each bolt past the nut (shall not be less than a minimum of 3 threads);
 - qualification of personnel: all personnel employed by the Supplier who are involved in the installation and pre-commissioning of the disconnecter and earthing switch shall be trained and accredited by the OEM. Proof of this accreditation shall be included in the quality control plan and shall be submitted to Eskom Transmission for approval prior to installation and pre-commissioning of equipment by the individuals concerned; and
 - final installation inspection and testing: instructions shall be provided for inspection and testing after the switchgear and controlgear has been installed and all the interfacing connections have been completed. These instructions shall include the following:
 - i. procedures for carrying out any adjustment that may be necessary to achieve correct operation;
 - ii. recommendations for any relevant measurements that should be made and recorded to help with future maintenance decisions; and
 - iii. instructions for final inspection and testing.
- d) The Supplier shall be responsible for ensuring the training and accreditation of persons employed for the installation and pre-commissioning of switchgear.
- e) During the performance of the work at the substation site, the Supplier shall comply with all the relevant statutes, regulations, bylaws and codes, as well as all the safety and quality requirements pertaining to the work. The Supplier shall provide all apparatus including safeguards and personal protective equipment (PPE), including a Fall Arrest System (FAS), necessary for the performance of the work.
- f) Installation tools / equipment and debris shall be removed from site when installation is completed.
- g) Where a.c. power supplies cannot be made available to the Supplier for installation and pre commissioning purposes, the Supplier shall be responsible for providing his/her own a.c. power supply (e.g. generator) for the installation and pre-commissioning of switchgear.

3.4.8 Pre-commissioning and onsite work requirements

3.4.8.1 On-site work requirements

The first unit to be erected under the contract/ once-off order shall be witnessed and written approval given by Eskom Transmission in order to ensure that the both the equipment and work carried out (including workmanship) is satisfactory and to establish the necessary standards for subsequent erection work. As part of this exercise the final alignment after main conductor attachment is to be included.

The Supplier shall be responsible for ensuring the training and accreditation of personnel employed and entrusted with the installation and pre-commissioning tests of switchgear.

3.4.8.1.1 Requirements for off-loading, installation (erection) and site testing

Erection of the equipment shall include:-

- a) Off-loading and supply of all equipment required for installation and inspection.
- b) On completion of the installation (erection) works removal from site of all surplus equipment.
- c) Site testing (pre-commissioning tests) of the installed equipment as specified in subclause 3.4.8.2 of this standard.

3.4.8.1.2 Competency of Installation (erection) and testing personnel

- a) All personnel appointed to supervise or act on the Contractor's behalf with respect to site installation (erection) and testing work shall be fully competent in the installation (erection) including assembly and the testing of the switchgear - and they shall be approved in writing by Eskom Transmission.
- b) The Supplier shall possess and maintain a Competency File containing pertinent details of all persons used to supervise and perform site installation (erection) and testing work.

Training and accreditation of all personnel employed and entrusted with on-site installation (erection) and testing, as well as obtaining written Eskom Transmission approval, shall be the responsibility of the Supplier.

3.4.8.2 Pre-commissioning

- a) Testing of each disconnecter and earthing switch after installation

Each disconnecter and earthing switch shall be tested after installation in accordance with tests listed under subclause 3.3.3. This is to assure proper installation and that no damage occurred during transportation. The pre-commissioning tests shall be witnessed by an appointed Eskom Transmission switchgear official or representative. To facilitate the testing, adequate d.c. power supplies, test equipment and suitably qualified and accredited personnel shall be provided by the Supplier.

3.4.8.2.1 Pre-commissioning test report

The disconnecter and earthing switch pre-commissioning site test report shall be submitted to Eskom Transmission, comprising the following parts:

3.4.8.2.2 Required measurements records

- a) after the measurements at the substation site, a hand-written pre-commissioning test report shall be handed over to the appointed Eskom Transmission switchgear official or representative. Any special note that is on the OEM operation and maintenance instruction manual and/or test protocol shall be incorporated by the Supplier on this report, e.g. "Activate anti-condensation heaters";
- b) within 3 weeks after the pre-commissioning tests, the Supplier shall submit an official signed off Site Pre-commissioning Test Report to Eskom Transmission (two hardcopies); and

- c) an electronic copy of the official report shall be provided on a digital record (portable format e.g. USB memory stick or CD) for each individual disconnector and earthing switch. The software used shall be compatible with one of the types of test equipment mentioned above. Reports shall be in .pdf or Microsoft Word (.doc) format.

3.4.8.2.3 Measured values

All the measured values shall be clearly stated in the report as well as the following:

- a) test/measuring equipment information/data:
- make and type of instruments;
 - serial numbers of instruments;
 - methods of triggering (operation pulse);
 - measuring methods;
 - the accuracy of the instruments; and
 - calibration certificates of the measuring instruments used, from an accredited laboratory, e.g. SANAS;
- b) the disconnector and earthing switch data:
- make and type;
 - serial numbers of poles and operating mechanisms;
 - rated voltage, normal current and short-time withstand current;
 - the name of the substation and section;
 - disconnector and earthing switch identification and application;
 - date of commissioning; and
 - date and time of testing/measuring.

3.4.8.2.4 Clear copies attached to the official report

Clear copies of the complete printouts of the timing, travel characteristics and dynamic main contact resistance measurements shall be attached to the official report. The names of all parties concerned shall be clearly stated in the report. If the measured values differ from the values as they were measured at the manufacturer's works, an interpretation shall be given and, if Eskom Transmission deems it necessary, the deviation shall be corrected by the Supplier. If the disconnector or earthing switch is found to be faulty during the tests, a fault report shall be completed in addition to the pre-commissioning test report.

3.4.8.3 The switchgear and controlgear shall be subject to a final inspection by Eskom Transmission

The switchgear and controlgear shall be subject to a final inspection by Eskom Transmission after pre-commissioning in accordance with the approved quality control plan.

- a) Provision shall be made during the erection phase for inspection and testing which should be made after the equipment has been installed and all connections have been completed. No equipment is to be handed over unless Eskom Transmission technical representative is satisfied as indicated on the handing over certificate.
- b) Care shall be taken to ensure that spares are protectively packed to enable satisfactory long-term storage.
- c) Small spares such as contact fingers, springs, bearings etc. will be stored indoors, but bulky items such as spare insulators, current paths, etc., etc. will be stored outdoors.

3.4.8.4 Final inspection to hand-over

After the final inspection, the final commissioning of the plant is performed and the hand-over documents shall be provided to Eskom Transmission by the Supplier.

3.4.9 Safety related data (where applicable)

All liquids or chemicals used during installation shall be supplied with Material Safety Data Sheets (MSDS). These shall be in accordance with Eskom Transmission SHEQ requirements.

3.4.10 Requirements for pressure vessels (where applicable)

Disconnecter and earthing switch, which are subject to the provisions of the Occupational Health and Safety Act regarding pressure vessels, shall be provided with certificates for the associated pressure vessels. These certificates shall be issued by an independent inspection authority approved by Eskom Transmission. The costs of such an inspection authority appointment shall be borne by the Supplier. The Supplier shall supply to the appointed inspection authority calculation sheets, design drawings and welding procedures of all pressure vessels for approval before manufacture commences. In addition, copies of sub-orders for bought-out vessels or works orders (if manufactured internally) shall be supplied to the appointed authority. Sufficient proof shall be provided that all welders employed in the fabrication of pressure vessels are adequately qualified and that their qualifications are valid.

3.4.11 After sales technical support

The Supplier shall provide locally based technical switchgear specialist support on a full time basis for the duration of the contract, of both the disconnector and earthing switch, and where applicable, its electronic online condition monitoring and/or integrated diagnostic devices. The Supplier shall provide details at tendering stage and upon contract awarding. If the Supplier fails to provide the technical switchgear specialist support during the life of the awarded contract, Eskom Transmission shall raise non-conformities and also escalate the lack of addressing this to contract management to resolve.

3.5 Inspection and maintenance

3.5.1 General

The effectiveness of maintenance depends mainly on the way instructions are prepared by the OEM and implemented by Eskom Transmission. The Supplier shall supply maintenance information in the form of OEM operation and maintenance instruction manuals, OEM test plan/ field service bulletins and digital Video record (portable format e.g. USB memory stick) material covering the following aspects:

a) Extent and frequency of maintenance:

For this purpose, the following factors shall be considered:

- i. switching operations;
- ii. total number of operations (Close and Opens operations or operating cycles);
- iii. environmental conditions;
- iv. measurement and diagnostic tests for condition monitoring ; and
- v. full maintenance analysis FMECA as per details below:-
 - The Supplier with their OEM factory shall prepare the FMECA datasheets for the offered disconnector and earthing switch type design and this shall be submitted with the tender documentation. This FMECA shall provide the details of the maintenance analysis to indicate the reasoning as to the identified maintenance activities and logistics requirements.

b) Scope of work to be performed:

It shall include the following:

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- i. recommended place for the maintenance work (indoor, outdoor, in factory, on-site, etc.);
- ii. procedures for inspection, diagnostic tests, examination overhaul;
- iii. reference to drawings;
- iv. reference to part numbers or standard kit of parts;
- v. tools required, including special equipment or tools, and the contact pressure setting tools;
- vi. precautions to be observed (e.g. cleanliness and possible effects of harmful arcing by-products);
- vii. lubrication procedures; and
- viii. cleaning materials.

c) Graphical information:

Detailed drawings and sketches of the disconnecter and earthing switch components, with clear identification (part number and description) of assemblies, sub-assemblies and essential components. Expanded detail drawings, which indicate the relative position of components in assemblies and subassemblies, are expected as a preferred illustration method. Graphs and similar means of portraying important information shall also be included.

d) Specified operational values:

Values and tolerances pertaining to which, when exceeded, make corrective action necessary, for example:

- i. pressure levels (where applicable);
- ii. operating times and, contact velocities (where applicable);
- iii. resistance of the main current carrying circuits;
- iv. where applicable, insulation and/or arc-extinguishing medium characteristics (e.g. the SF6 purity, dew point, acidity, etc.);
- v. where applicable, quantities and quality of gas;
- vi. contact condition (including contact dimensions);
- vii. torque settings for fasteners; and
- viii. important dimensions and adjustments.

e) Specifications for materials:

This includes warnings of known non-compatibility of materials.

- i. fluid; and
- ii. cleaning and degreasing agents.

f) Tools, lifting and access equipment:

A list of standard and specialised tools shall be provided with description of their application and associated part number.

- i. A full list of operating tools shall be provided with the tender documentation. If additional sets of operating tools are required, this shall be specified in schedule A.
- ii. If there is a requirement for special tools this shall be detailed here. Included shall be the lifting equipment and slings necessary for installation and disassembly.
- iii. All operating tools shall be fitted on the inside of the mechanism enclosure.

g) Tests after the maintenance work:

All tests shall be clearly described and shall include the parameters to be observed.

h) Spare parts:

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Description, reference number, quantities and advice for storage.

i) Time estimates:

Estimated time required to carry out maintenance activities.

j) Detailed information:

This relates to the recommended makes and types of special tools and equipment (as well as the brackets, fittings and so forth that are needed during inspection and maintenance) forming part of the special maintenance tools for the disconnecter and earthing switch. The OEM operation and maintenance instruction manual shall show clearly how these, together with any brackets, fittings, etc, shall be mounted and applied on the disconnecter and earthing switch.

k) Dismantling and replacement of major parts:

Precise details for dismantling and replacement of major parts shall be provided.

3.5.2 Maintenance Digital Video recording

It is anticipated that maintenance intervals for the disconnectors and earthing switches will be very long, e.g. several years. Consequently, it is essential that the OEM operation and maintenance instruction manual be supplemented and supported by a maintenance-orientated video recording. The digital Video recording shall be converted into a suitable portable format e.g. USB memory stick. A written commitment from the Supplier regarding the submission of the maintenance digital Video recording shall be provided with the tender documentation (refer to subclause 3.2.26.1). The actual digital Video record (portable format e.g. USB memory stick) shall be supplied after awarding of the contract following approval of the OEM operation and maintenance instruction manual by Eskom Transmission. Copies of the digital Video record (portable format e.g. USB memory stick) shall be issued to the contract manager and relevant technical switchgear specialists.

The maintenance digital Video recording shall provide a record of the maintenance requirements and procedures for the equipment supplied, this shall include the commissioning and maintenance of the electronic controller (Controlled Switching Device/ Point-on-Wave (PoW) switching device). The digital Video recording and related OEM operation and maintenance instruction manuals shall be detailed enough to enable a trained maintenance crew (with some general knowledge of the equipment) to perform all inspections and maintenance required on the equipment. It is anticipated that the OEM operation and maintenance instruction manuals will list what maintenance is required, while the digital Video recording will show how such maintenance is achieved.

The maintenance digital Video recording shall cover routine inspection, minor maintenance, major maintenance (overhaul/ intrusive inspection) and repairs (upon breakdown) of all equipment requiring such work, as well as some trouble-shooting techniques (repairs upon emergency breakdown) and tips. It shall explain the normal operation of the equipment in sufficient detail for the maintenance crew to be able to differentiate between normal and abnormal equipment performance. The digital Video recording shall concentrate on equipment maintenance and repairs (upon breakdown), shall not include any unnecessary sales or publicity material. Since the topics to be covered are extensive and complex, it may be considered an advantage to present the results in definite sections, covering the various aspects or portions of the equipment.

These sections may be on separate digital Video recordings or if consolidated into a single digital Video recording, there shall be adequate indexing to permit quick access to the desired section. For each piece of equipment requiring maintenance, the maintenance digital Video recording shall show:

- the tools, equipment and materials required to perform the maintenance, especially any special tools;
- the tests required prior to maintenance operations to record the status of the equipment and/or to indicate the areas requiring maintenance/re-adjustment;
- the disassembly steps, including any marking of positions required prior to disassembly, any discharging of pressure and/or stored energy;
- the disassembly, removal, replacement and re-assembly of any sub-components requiring scheduled maintenance/replacement;

- the re-assembly, realignment and re-installation of all components, including any lubrication of moving parts;
- where applicable (for GIS/ MTS), a brief summary of the evacuation, refilling and leak testing of the re-assembled equipment;
- the testing of the re-assembled equipment, including acceptable values and tolerances of the measured/tested parameters; and
- some trouble-shooting methods if the required tolerances are not achieved.

The trouble-shooting portion of the maintenance digital Video recording shall record the normal/expected values of equipment performance, plus techniques and tips to analyse the cause of any abnormalities, and how to correct them.

3.5.3 Tools and spares

- a) A full set of operating tools necessary to carry out all mechanical (manual) operations of the disconnecter and earthing switch shall be supplied with each disconnecter and earthing switch (e.g. racking handle for manual operation, etc.).

A full list of operating tools shall be provided with the tender documentation (refer to subclause 3.2.26.1). If additional sets of operating tools are required, this will be specified in Schedule A.
- b) All operating tools shall be fitted on the inside of the front access door of the operating mechanism enclosure.
- c) A detailed list of standard tools required for minor maintenance shall be supplied with the tender documentation (refer to subclause 3.2.26.1). Where applicable, the following tools are required for minor maintenance:
 - slow operating device(s);
 - hoses and fittings for draining and filling with SF6 gas or other insulation and/or arc-extinguishing medium; and
 - other tools which may be required (e.g. contact alignment tools, where applicable, insulation and/or arc-extinguishing medium density meter checking device).
- d) Should the disconnecter and earthing switch require additional specialised tools for major maintenance purposes, a full list of specialised maintenance tools shall be provided with the tender documentation (refer to subclause 3.2.26.1).
- e) A full list of spares required for maintenance shall be provided with the tender documentation (refer to subclause 3.2.26.1).
- f) The Supplier shall provide the written letter with the tender documentation that states that in case of the design obsolescence, they shall notify Eskom Transmission and present all spares manufacturing drawings and specification (i.e. metal, Bill of material, masses) for the maintenance spares required for disconnecter and earthing switch life expectancy.

3.5.4 Spares

3.5.4.1 General

Spares will normally be purchased at the same time that orders are placed for disconnectors and earthing switches. The Supplier shall provide a list of the minimum recommended spares (refer to subclause 3.2.26.1g)) together with prices in the pricing schedules for the disconnectors and earthing switches concerned.

NOTE: Delivery to any of the specified destinations should remain valid for the duration of the contract period and be subject to the same Contract Price Adjustment formula as applied to the disconnectors and earthing switches.

3.5.4.2 Availability of spares

The Supplier (who represents the OEM), shall be responsible for ensuring the continued availability of spare parts required for maintenance for a period of not less than 25 years from the date of discontinuation of the switchgear and controlgear.

Spares required under emergency breakdown conditions shall be readily available with a maximum lead time of 24 hours from date of purchase order. The Supplier shall state the lead time offered in Schedule B. This excludes spares required for scheduled maintenance.

The Supplier upon contract awarding shall carry the following spares and shall be readily available locally (in South Africa) within a minimum of 24 hours (up to a maximum of 14 days), when Eskom Transmission emergency requires to restore the disconnector or earthing switch for its network:

- gears for operating drive mechanism;
- d.c. motor drives;
- d.c. conversion kits (from 110 V d.c. to 220 V d.c.);
- d.c. conversion kits (from 220 V d.c. to 110 V d.c.);
- contactors and relays; and
- copper main contact pieces;
- trapeze contact assembly;
- bus transfer current devices;
- induced current devices;
- where applicable (for GIS/ MTS), SF6 density monitoring devices (If applicable, other insulation and/or arc-extinguishing medium).
- electronic online condition monitoring and/or integrated diagnostic device

The Supplier shall undertake to supply to Eskom Transmission all the necessary replacement parts for the disconnector and earthing switch throughout its expected service life. If the manufacture of the specific make and type of disconnector and earthing switch (or any of its replacement parts) is discontinued, Eskom Transmission shall be advised by the Supplier in writing.

Written advice (relating to discontinuation) shall also be provided for parts of the equipment that the Supplier obtains from a third party (sub-Supplier). In this situation, the Supplier shall supply the following information to Eskom Transmission:

- all design data;
- all material characteristics and parameters;
- all testing information (parameters, equipment, methods, criteria, etc.);
- all manufacturing information; and
- all relevant working drawings and information.

This information shall be supplied to Eskom Transmission in a legible and acceptable format in English when notice of discontinuation of the disconnector and earthing switch or any of its replacement parts is given. In this case, Eskom Transmission will be able to make alternative arrangements to obtain the necessary replacement parts. Another option is to pool spare parts: the Supplier shall state his/her spares availability philosophy with the tender documentation (refer to subclause 3.2.26.1).

3.5.4.3 Identification of spares

Spares shall be identified by a unique number and cross-referenced in the OEM operation and maintenance instruction manual. Large spares such as poles and operating shafts shall be packed in separate cases, clearly labelled and consigned to Eskom Transmission. Such large spare items shall be provided with a metal label bearing the appropriate identification.

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A parts list shall be provided with each consignment of spares, clearly identifying each item by description, identification number and quantity supplied. The contract number shall appear on the packaging containing spares.

3.5.4.4 Packaging, preservation and storage of spares

For details on how to handle preservation, the Supplier shall also refer to subclause 3.4.6 and the Eskom Transmission Quality documentation requirements. Care shall be taken to ensure that spares are protectively packed for satisfactory long-term storage. Maintenance spares will usually be stored indoors.

- a) Large spares such as complete current paths and motor drives shall be packed in separate cases, clearly labelled and consigned to Eskom. Such large spare items shall be provided with a metal label bearing the appropriate identification.
- b) A parts list shall be provided with each consignment of spares, clearly identifying each item by description, identification number and quantity supplied. The contract number shall appear on the cases containing spares.

3.5.4.5 D.C. supply voltage conversion kits

In accordance with this standard specification subclause 3.2.11.2b) and c), the d.c. supply voltage "conversion kits" shall be kept locally by the Supplier in South Africa for the duration of the contract to ensure that they are readily available as and when required. Separate "conversion kits" shall be made available that are able to convert from 110 V d.c. to 220 V d.c. or from 220 V d.c. to 110 V d.c.

3.5.5 Modifications to disconnectors and earthing switches during their service life

If, during the normal service life of a disconnector and earthing switch supplied, Eskom Transmission requires to be notified about a necessary modification, a field Service Bulletin shall be issued to the Eskom Transmission contract manager and relevant technical switchgear specialists giving details of the modification and the reason for it. Suitable training and parts shall be supplied to Eskom Transmission within 30 days of any modification required for all disconnectors and earthing switches supplied to Eskom Transmission. All concessions shall be approved by Eskom Transmission.

3.5.6 Condition monitoring of disconnectors and earthing switches

The Supplier and OEM factory shall provide practical and innovative methods to improve the reliability and maintainability of the disconnectors and earthing switches installation. This shall include offering Eskom Transmission the electronic online condition monitoring and/or integrated diagnostic devices which meets the minimum requirements of the Eskom Transmission standard (240-1489922148), and achieves the following functions:

- Contact wear (per pole) (e.g. due to hot connection, insufficient contact pressure, etc),
- Wear due to difficulty to operate (e.g. rust, corrosion, lubricant overused); and
- Continuous monitoring, recording and alarm signalling of the mechanical operating characteristics of the disconnector and earthing switch.

The electronic online condition monitoring and/or integrated diagnostic device shall be IEC61850 protocol compliant.

All information required to carry out condition monitoring of disconnectors and earthing switches (including, but not limited to, specification sheets, etc.) shall be provided by the Supplier and OEM for each type of disconnector or earthing switch. Preventative maintenance plans and schedules shall be displayed in the form of tables, charts and flow diagrams.

- a) For the operator level a basic inspection checklist shall be provided detailing minor inspection requirements.
- b) Required routine checks and maintenance actions of a minor and major nature required in order to ensure correct operation of the equipment.

This information shall be given to the Eskom Transmission contract manager and relevant technical switchgear specialist upon awarding of the contract.

3.6 OEM Operation and Maintenance Instruction Manuals

3.6.1 General

Transport, storage, installation (erection), operation, maintenance, testing and breakdown fault-finding information shall be submitted in the form of OEM operation and maintenance instruction manuals (refer to subclauses 3.2.26.1, 3.2.26.3 3.2.26.2 and 2.26.3) for the disconnecter or earthing switch and where applicable, also its associated electronic online condition monitoring and/or integrated diagnostic device. These OEM operation and maintenance instruction manuals shall be in English and provided in the following formats:

- hard copy A4 form; and
- electronic copy (pdf) form copied onto an appropriate portable digital medium such as USB memory stick and Compact Disc (CD).

The OEM operation and maintenance instruction manual and contents shall be approved by Eskom Transmission. The approval process shall be initiated immediately upon contract award and completed within three months. The onus shall be upon the Supplier to meet this programme. If further material is required, then this shall be subject to negotiation.

3.6.2 Content

The OEM operation and maintenance instruction manual(s) shall cover transport, storage, installation, operation, maintenance (minor maintenance, condition-based maintenance and major maintenance), testing and breakdown fault-finding, and shall fulfil the following requirements:

- i. the OEM operation and maintenance instruction manuals shall be written in English only;
- ii. it shall be specifically compiled for the disconnecter and earthing switch with which it has been supplied, and where applicable, also for its associated electronic online condition monitoring and/or integrated diagnostic device;
- iii. torque wrench settings, clearances, settings and other important information shall be listed, e.g. the typical operating times, speed curves and tolerances in synchronism;
- iv. it shall give a clear description of the operation, and the diagrams, photos and description shall be easily read together;
- v. routine inspection, minor and major maintenance procedures shall be given together with a list of lubricants, recommended spares and/or special tools and so on, required for these activities;
- vi. it shall contain high-quality diagrams and photos showing details of operating components of the disconnecter or earthing switch, which also identify and list separately each component making up the diagram;
- vii. seals (o-rings), gaskets, bushes, bearings and gears requiring replacement during major maintenance (overhaul/intrusive inspection) and repairs (upon breakdown) shall be detailed and the Suppliers of these components, together with the part number(s), shall be listed; and
- viii. the names and addresses of Suppliers of lubricants, compounds, gases (where applicable), and so on shall be listed.

One set of sample OEM operation and maintenance instruction manual(s) shall be supplied to Eskom Transmission with the tender documentation (refer to subclause 3.2.26.1) for approval. After approval, the requisite number of OEM operation and maintenance instruction manuals shall be supplied.

Suitably trained and qualified personnel shall install, operate, maintain and repair the equipment with the aid of the manufacturer's operation and maintenance instruction manuals and digital Video record aids (portable format e.g. USB memory stick).

The OEM operation and maintenance instruction manuals shall contain at least the following information (where applicable):

a) General

- title page: title of equipment, equipment ratings, contract and order numbers, Supplier's reference numbers. This information shall also appear on the outside of the binder and on the first page;
- table of contents: the OEM operation and maintenance instruction manual shall be sectionalised and numbered sequentially;
- equipment make and type to which the OEM operation and maintenance instruction manuals apply;
- list of all drawings, by number and title;
- description and summary of disconnecter or earthing switch operation;
- details of interlocking between disconnecter or earthing switch;
- schematic wiring diagram of disconnecter or earthing switch; and

b) Transport, handling and storage instructions (also long-term storage requirements for preservation)

- packaging requirements;
- transport instructions;
- transport instructions
- storage instructions: indoor, outdoor and special information for equipment storage; and
- the measures required to make sure all the manufacturer's transportation and storage requirements are met (also long-term storage requirements for preservation).

c) Installation instructions

- complete step-by-step instructions and detailed drawings, including alignment, installation and dimensional tolerances for preparing the equipment for service;
- inspection procedures before and after unloading, pre-installation tests, and where applicable, gas-filling and monitoring procedures;
- the levels of expertise required for the construction team;
- a man-hour estimate for the installation work required on site;
- a list of special equipment and tools required for unloading and positioning components of the disconnecter or earthing switch on site; and
- tolerances for field assembly.

The Supplier shall supply a digital Video record (portable format e.g. USB memory stick) to supplement installation information given in the OEM maintenance instruction manual. This visual information may be provided separately or may form part of the maintenance digital Video record (portable format e.g. USB memory stick) required.

d) Testing

- functional testing, dielectric testing (where applicable), operating instructions, operating limits and starting-up instructions (complete with sketches or drawings); and
- a separate set of record sheets, showing measurements and tolerances for each test for separate items of equipment.

e) Inspection and maintenance, including condition-based maintenance

- the OEM operation and maintenance instruction manual shall contain the typical contents as described in 3.6.2.

f) Dismantling, repair (upon failure or intrusive maintenance), settings inspection and lubrication

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- instructions for dismantling the equipment, as well as repair instructions and settings of critical clearances and adjustments, complete with photographs and sketches or drawings;
- special tools shall be clearly described;
- guide to inspection frequency;
- all seals (o-rings), gaskets, bushes, bearings and gears which have to be replaced during scheduled maintenance or after a specified period, shall be identified;
- lubrication chart and schedule (including component quantities). Lubricants shall be clearly identified. If no lubrication is required, it shall be clearly stated;
- procedures to perform manual operation (use of manual operating arm) in the motor driven disconnectors;
- procedures for the discharge of operating energy in the mechanical and electric systems;
- where applicable, procedures for the safe disposal of decomposed SF6 gas products shall be described; and
- trouble-shooting procedures shall be provided.

g) Spare parts

- spare parts list, including quantities and manufacturer's part numbers. Spare part numbers shall be cross-referenced with drawings in the OEM operation and maintenance instruction manual;
- drawings (sectional or "exploded" views, etc.) of the equipment/sub-assemblies shall identify every component (excluding standard bolts, nuts, washers, etc.) referenced to the spare parts list, including component description and manufacturer's part number; and
- delivery times for recommended spare parts shall be stated.

h) Drawings for equipment

- a complete set of approved drawings specific to the equipment being supplied. The drawings shall show dimensions and tolerances of the major components and assemblies. Details of the drawings required are given under subclauses 3.2.25, 3.2.26.1, 3.2.26.2 and **Annex D**.
- a complete set of approved drawings for the electronic online condition monitoring and/or integrated diagnostic device.

3.7 Training

The Supplier shall provide with tender documentation the details of the first-hand training of an international standard on the supplied equipment by OEM accredited instructors, and this shall be available for the duration of the contract. The OEM supplied equipment that is covered by the offered training and its material shall include the disconnector and earthing switch with its the insulation and/arc-quenching medium, and where applicable, it's electronic online condition monitoring and/or integrated diagnostic devices.

For new contracts or once-off order/turnkey, the Supplier shall ensure that:

- technical equipment training is offered upon first delivery (or installation). In the case of the long-term contract awarded, the Supplier shall rollout technical equipment training first-off delivery (installation) to each of the Eskom Transmission grids (at provincial level) for the duration of the contract.
- this training shall cover storage, packaging (unpackaging), handling, assembling, installation, setting/adjustments, pre-commissioning testing, handing-over, condition-based maintenance inspection tests (tolerance setting verification and adjustments), and the aspects of dismantling and disposal. The Supplier shall provide details of this training with tender documentation.
- This training shall also provide electronic online condition monitoring and/or integrated diagnostic devices training as a line item on the contract. This training shall cover the design, application, operation, settings, commissioning and maintenance of the device, including any applicable software. (Refer to **Annex E**)

- Upon contract award, the Supplier shall prepare training material documentation (in English) with guidance of Eskom Transmission in terms of the details covered.

The intrusive major maintenance (servicing) and breakdown repairs shall be specialized training to be conducted at the OEM factory. Its scope shall include product design aspects, drawings, parts, quality assurance, assembling, testing and disassembling inspections, repairs and testing. The Supplier shall provide details of this training with tender documentation. Eskom Transmission shall arrange with the Supplier to receive this intrusive technical equipment training as and when the need arise.

Refer to **Annex E** for the switchgear training requirements from original equipment manufacturers. The Supplier shall provide with the tender documentations, the detailed training programme in accordance with this standard specification.

3.8 Safety, health, environment, and quality

Refer to Eskom Transmission documentation issued for SHEQ requirements in order to comply with this disconnectors and earthing switches standard specification.

All facets of this tender must comply with Occupation Health and Safety Act (OHS Act) No 85 of 1993 – Construction and Electrical Machinery Regulations.

3.9 Technical submission minimum tender returnables

3.9.1 Minimum tender returnables of the offered disconnector and earthing switch

In order for the Supplier's technical tender submission to be considered for performing evaluation by Eskom Transmission evaluators or its appointed representative, the submission shall contain these minimum technical tender returnables in accordance with Eskom Transmission Technical Evaluation Criteria (240-180000573):-

- Completed Technical A & B schedules
- Type test reports
- Drawings (General Arrangement Outline, Wiring Schematic and Nameplate)
- OEM Operation and Maintenance Instruction Manuals

Should the Supplier not submit the above-mentioned minimum technical returnables documentation, the Eskom Transmission evaluators or its Representative shall consider the technical submission unresponsive and not proceed with further technical evaluation, thus that technical submission is disqualified.

Eskom Transmission shall perform technical evaluation in accordance with Eskom Transmission Technical Evaluation Criteria (240-180000573).

3.9.2 Minimum tender returnables of the offered electronic

For the offered disconnector and earthing switch that is offered with its electronic online condition monitoring and/or integrated diagnostic devices, the Supplier shall submit the minimum tender returnables in order for Eskom Transmission to perform technical evaluation of that. This shall respond in accordance with the User specification 240-1489922148).

4. Authorization

This document has been seen by:

Name and surname	Designation
Bheki Ntshangase	Senior Manager Substation Equipment & Diagnostics
Jabulani Cebekhulu	Chief Engineer, AM SED (AIS Care Group Convener)

5. Revisions

Date	Rev.	Compiler	Remarks
Mar 2023	1	S Nkosi	Final authorised official document
Jan - March 2023	0.4	S Nkosi	Circulated for comments to interested and affected parties.
Nov 2022	0.3	S Nkosi	Re-arrange the document and updated referenced details.
Sept 2022	0.2	S Nkosi	Combine Transmission requirement for all circuit-disconnectors and earthing switching and the Switchgear Training
Sept 2022	0.1	S Nkosi	New document applicable to Eskom Transmission only with its 240-numbering, which is a departure from 240-56063815 Rev 3
Sept 2015	3	I. Sibeko	240-56063815 Rev 3: Final Document for Authorisation

6. Development team

The following people were involved in the development of this document as well as previous revisions of this standard specification. The original document was compiled by Transmission and Distribution switchgear representatives.

- Sphiwe Nkosi Substation Equipment & Diagnostics, Asset Management, Transmission
- Jabulani Cebekhulu Substation Equipment & Diagnostics, Asset Management, Transmission

7. Acknowledgements

The Compiler acknowledges the contributions to this new document and all those who contributed on the last 240-56063815 Rev 3, 240-46425564, 240-124520996 Rev 1 and 240-56065202

Annex A – Supplier and Eskom Transmission responsibilities

The responsibilities of Eskom Transmission and the Supplier of the switchgear and associated equipment shall be as defined below.

A.1 Supplier's responsibilities

The Supplier shall be responsible for, but not limited to, the following:

- a) upon submission of a tender, the submission of a complete set of technical documents as required by this standard specification (refer to subclause 3.2.26 for documentation requirements), this shall be in paper print, Adobe PDF copy and all the technical schedules A and B shall also be submitted in a copy of the Microsoft Excel format.. The tender shall state clearly all deviations (if any) in the Deviation schedule and in Schedule B (if applicable). Deviations will be evaluated by Eskom Transmission and the outcome will be communicated, in writing, to the Supplier;
 - i. The Supplier, as indicated in subclause 3.9, shall also read the Technical Evaluation Criteria standard (240-180000573) and provide with tender documentation all the minimum technical tender returnables in order for the technical documentation to be evaluated by Eskom Transmission. Failing to provide information called by this standard specification and the Technical Evaluation Criteria standard (240-180000573) shall render the technical submission disqualified for technical evaluation.
- b) submit with tender documentation the disconnecter capability on continuous or temporary overload due to changed service conditions (refer to subclause 3.3.2.1.3);
- c) submit with the tender documentation a written commitment regarding the submission of the maintenance digital Video recording;
- d) upon contract award, submit documentation listed under subclause 3.2.26.2, this shall include speedily submitting switchgear drawings for Eskom Transmission commenting and approval signing off;
- e) all testing and recording of results required by this standard specification as well as the OEM's own protocols using accredited personnel including the use of approved and calibrated test equipment. Type testing shall be carried out in accordance with the relevant IEC product standards. All testing shall be done at accredited local test facilities (SANAS accredited – e.g. SABS) or accredited international testing authorities (e.g. KEMA/CESI/IPH);
- f) in the case of inspection at the factory of disconnectors and earthing switches for use on systems with nominal voltages up to and including 765 kV, the erection of a completely functional prototype at the Supplier's own premises under direct supervision of the OEM for a comprehensive design reviews inspection by Eskom Transmission before erecting on site. Unless otherwise agreed by Eskom Transmission;
- g) all necessary arrangements for factory routine testing and/or acceptance testing (FAT), transporting and off-loading at the most convenient point (if applicable), as well as for transporting and off-loading at the ultimate destination. Eskom Transmission will only accept delivery to the destination specified at the time of placing the order – unless otherwise negotiated. Shafts, bearings and machined surfaces exposed during transport and storage shall be treated with a temporary anti-corrosive coating;
- h) ensuring equipment is in an acceptable and safe working condition during all phases of transportation from factory to site, storage until the point of official handing over;
- i) provision of OEM accredited installation and pre-commissioning services for all on-site work;
- j) the supply of all documentation relevant to the disconnecter and earthing switch including factory routine test results. Records shall be available during the pre-commissioning (on-site) testing phase;
- k) Supply of all equipment in acceptable working condition for on-site handover, inclusive of all phases prior to handover i.e. packaging, transportation, storage and erection on site (if applicable).
- l) Provision of all necessary auxiliary equipment such as manual operating handles for motor drives.

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**

Revision: **1**

Page: **74 of 91**

- m) the supply of all conductor main HV terminals on the supply and load side, and all necessary bolts and fasteners for erection and any further items required to complete the installation. This shall include disconnector's bus transfer current switching device (BTCSD), earthing switches induced current switching device (ICSD) and their mounting accessories required complete installation;
- n) For disconnectors of the pantograph type, provision of all its associated equipment such as upper trapeze main contact assemblies (including its bus transfer switching devices (BTCSD)), upper conductor clamping arrangements and main terminal adapters (mounting accessories) required to fit on the Eskom Transmission busbar (types tubular and flexible (twin bull and triple bull));
- o) the supply of all necessary auxiliary equipment, including operating mechanisms, control, monitoring and protective devices, installed in suitable operating mechanism enclosures;
- p) the supply of all auxiliary and control wiring and terminations for the disconnector and earthing switch, including inter-pole cabling and cabling to the central control enclosure(s) (for pantographs and 765 kV). For single-pole operated disconnectors the wiring shall be done in the factory. No additional inter-pole wiring on site is allowed;
- q) the supply of all electrical and mechanical interconnections between the elements of the disconnector and earthing switch – made to Eskom Transmission's approval;
- r) where applicable (for GIS and MTS), the first filling of the insulation and/or arc-extinguishing medium to the OEM's rated value;
- s) when required, the supply of a fully complete disconnector and earthing switch assembled, installed, pre-commission (on-site) tested and ready for handover (including, where applicable, controlled switching systems);
- t) where necessary (i.e. in the absence of an on-site a.c. power supply), the supply of an a.c. power supply (e.g. generator) for the installation and pre-commissioning of switchgear;
- u) Where anti-condensation heaters need to be energised, an electrical connection point (refer to subclause 3.4.6k)) shall be provided to enable Eskom Transmission to supply power to the heaters.
- v) the supply of all fixing bolts, fasteners and adapter plates – excluding the bolts required for fixing support structures to concrete foundations (which are to be supplied by Eskom Transmission);
- w) when specified on the specific Technical Schedule A & B, the supply of the steel support structures for the disconnector and earthing switch;
- x) Checking and verifying that supporting structures are erected and aligned to the requisite standard before commencing with erection.
- y) Final alignment and adjustment of disconnector and earthing switch after connection of the main conductors;
- z) when required, testing and recording of results required by this standard specification as well as the OEM's own protocols using accredited personnel including the use of approved and calibrated tools and test equipment;
- aa) Supply of complete disconnector and earthing switch ready for handing over;
- bb) provision of all training in accordance with this standard specification (refer to subclause 3.3 and **Annex E**) by OEM accredited trainers;
- cc) submit FMECA datasheets for each offered disconnector and earthing switch type design;
- dd) provide the electronic digital online condition monitoring and/or integrated diagnostic devices, with associated equipment and documentation to Eskom
- ee) where applicable, any modifications required during the disconnector and earthing switch service life notify Eskom Transmission for assessment and approval, and provide a detailed Field Service Bulletin;

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- ff) Upon order placement provide and deliver spares to the specified sites or stores. Retaining spares for 25 years after disconnector or earthing switch design manufacturing discontinuance. Also notify Eskom Transmission where particular spares are no longer supplied and or provided; and
- gg) any other Supplier's responsibilities as specified in this document.

A.2 Eskom Transmission's responsibilities

Eskom Transmission shall be responsible for the following:

- a) the supply of the relevant standard(s) or specification(s) and completed Schedule A's with the enquiry;
- b) the evaluation of all equipment offered and documentation supplied with a tender. This includes the compilation of an evaluation report summarising the outcomes of the evaluation;
- c) when required, subject to Eskom Transmission discretion, perform the Design Review inspection assessment of the offered disconnector and earthing switch at the relevant OEM manufacturing facilities before any first manufacturing of Eskom Transmission specified disconnector and earthing switch;
- d) when required, subject to Eskom Transmission discretion, perform the Factory Acceptance Testing (FAT) of the offered disconnector and earthing switch upon first-of manufacturing at the relevant OEM manufacturing facilities;
- e) when required, the assessment and evaluation of the relevant transport, storage and preservation, installation and pre-commissioning facilities;
- f) allocate Eskom Transmission drawing numbers and the approval of all drawings submitted by the Supplier after contract award (e.g. general arrangement, nameplate, schematic wiring, etc.), and provide the Supplier with Eskom Transmission standard wiring interface drawings and the standard steel support structure drawings;
- g) the approval of all other documentation provided by the Supplier (e.g. OEM operation and maintenance instruction manuals, training material, inspection and testing plans, maintenance digital Video record (portable format e.g. USB memory stick) and other supporting documents etc.);
- h) the supply of a heater connection point for long term storage;
- i) provision of the Eskom Transmission standard interface steel support structures and civil foundations for disconnector and earthing switch to be install at 400 kV substations and below. For special installations and refurbishments, specify (at the time of placing the order) whether the steel support structure for the disconnector and earthing switch is required to be supplied by the Supplier;
- j) where applicable when specified upfront, the approval of the disconnector and earthing switch steel support structure and provide the concrete foundations;
- k) supply the Eskom Transmission standard civil foundations for disconnector and earthing switch to be install at substations of voltages above 400 kV;
- l) the stringing and clamping of main conductors for the conventional disconnector, 765 kV disconnectors and the lower gearbox main contact of pantograph. For pantograph's upper trapeze main contact (suspended on busbar), to provide height (mm) of the busbar for the Supplier to install their trapeze mounting accessories and the trapeze main contact;
- m) the supply and installation of the control cabling to the disconnector and earthing switch operating mechanism enclosure; Also the secondary cabling, substation identification labels, connections to the substation earth mat and standard type padlocks;
- n) the supply and installation of all control, metering, relaying and annunciation equipment remote from the disconnector and earthing switch;
- o) where applicable (for GIS and MTS), the insulation and/or arc-extinguishing medium for filling to the OEM's rated value;

**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**

Revision: **1**

Page: **76 of 91**

- p) if necessary, provide suitable storage facilities where disconnectors and earthing switches are to be stored for extended durations prior to installation due to unplanned delays; and
- q) the witnessing and approval of the first complete disconnector and earthing switch delivered, installation and pre-commissioning.
- r) when installation is done by the Supplier, Eskom Transmission to witness testing as per QITP holding point. This shall include receiving test reports produced by the Supplier for the equipment.

Annex B – Technical Schedule A & B (Generic typical example)

Below is the generic typical example of the Technical Schedule A & B that is issued accompanying this disconnector and earthing switch standard specification:

Technical Schedules A and B for HV Outdoor disconnectors 132kV 2500A 40kA 220VDC Motor Operated Pantograph Disconnecter with Earthing Switch

Schedule A: Purchasers specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

1	2	3	4	5
Item	Clause of 240- 180000569	Description	Schedule A	Schedule B
1		Purchasing details		
1,1		• Quantity of units required		
1,2		• SAP No	0642692	xxxxxxxxxx
1,3		• Region		
1,4		• Site Name		xxxxxxxxxx
1,5		• Nearest Town		
1,6		• Province		xxxxxxxxxx
1,7		• Distance from nearest town km		
1,8		• Access to site		
2		Delivery and off-loading		
2,1		• Disconnecter delivered to:		
2,2		• Delivery effected not before Date		
2,3		• Erection completed not later than Date		
2,4		• Off-loaded from transport vehicle and transferred to intended operating position by Supplier. Yes/ No	YES	
2,5		• Construction supply available		
3	3	Site conditions of service		
3,1		• Altitude m	1 800	
3,2		• Ambient air temperature range		
3,3		Maximum (Peak) °C	+45	
3,4		Highest average daily °C	+35	
3,5		Lowest average daily maximum °C	+5	
3,6		Minimum °C	-10	
3,7		Maximum average daily variation °C	25	
3,8		Design level °C	50	
3,9		• Icing conditions Class 1 or 10	Class 10	
3,10		• Humidity		
3,11		Relative humidity conditions		
3,12		Minimum %	5	

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**
Unique Identifier: **240-180000569**Revision: **1**Page: **78 of 91**

3,13		Maximum	%	99	
3,14		Average	%	50	
3,15		• Solar radiation	W/m ²	1 100	
3,16		• Basic design velocity	km/hr	115	
3,17		• Maximum wind speed	km/hr	144	
3,18		• Wind loadings	Pascals	1 000	
3,19		• Lightning flash density	flashes/km ² /y r	8	
3,20		• Seismic	g	0,3	
3,21		• Classification of corrosivity of atmosphere (Severe / heavy industrial or marine)	Very high	C5 marine	
4		System conditions of service			
4,1		• System voltage	kV	132	
4,2		• Number of phases		3	
4,3		• Nominal system frequency	Hz	50	
4,4		• System earthing		Effectively earthed	
4,5		• Rated d.c. supply voltage of closing and opening devices and of auxiliary and control circuits (U_a)	V d.c.	220	
4,6		• Rated a.c. supply voltage of heaters and other a.c. auxiliary circuits (U_a)	V a.c.	230	
4,7		• Details of measures taken to prevent corrosion		xxxxxxxxx x	
4,8		• Expected life	years	40	
5	4	Disconnecter ratings (SANS 62271-102)			
5,1	4,1	• Rated voltage (U_r)	kV	145	
5,2	4,4	• Rated normal current (I_r)	A	2500	
5,3	4,5	• Rated short-time withstand current (I_k)	kA	40	
5,4	4,5	• Short-time withstand current duration (t_k)	s	3	
5,5	4,6	• Rated peak withstand current (I_p)	kA	100	
5,6	4,2	• Rated short-duration power frequency withstand voltage U_d			
5,7		Common value	kV	230	
5,8		Across isolating distance	kV	265	
5,9	4,2	• Rated lightning impulse withstand voltage U_p			
5,10		Common value	kV	550	
5,11	4,2	Across the isolating distance	kV	630	
5,12	4,15	• Mechanical endurance class	M1 or M2	M2	
5,13		• Rated value of bus transfer current for DS (minimum)	A	1600	
5,14		• Contact resistance with tolerance (terminal to terminal)	$\mu\Omega$	xxxxxxxxx x	
5,15		• Overload capability (continuous/temporary) for higher than rated	A	xxxxxxxxx x	

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**Revision: **1**Page: **79 of 91**

		normal currents (SANS 62271-1 Cause 8.2)		
5.16		• Ambient temperature limit for overload capability °C	xxxxxxxxx x	
5.17		• Duration of the temporary overload capability (maximum) s	xxxxxxxxx x	
6	4	Earthing switch ratings (SANS 62271-102)		
6,1	4,1	• Rated voltage (Ur) kV	145	
6,2	4,5	• Rated short-time withstand current (Ik) kA	40	
6,3	4,6	• Rated peak withstand current (Ip) kA	100	
6,4	4,7	• Short-time withstand current duration (tk) s	3	
6,5	4,11	• Rated short-circuit making current for ES kA	100	
6.6	4,14	• Rated induced current switching for Class A or B ES	Class A or B	
6,7	4,14	• Rated induced voltage switching for Class A or B ES	Class A or B	
6,8	4,16	• Rated electrical endurance for ES Class E0/ E1/ E2	Class E1	
6.9		• Contact resistance with tolerance terminal to terminal) μΩ	xxxxxxxxx x	

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Annex C – Material and Corrosion Protection information

Below is the **Table C1** that details the Eskom Transmission requirements that need to be completed by the Supplier and their OEM factory, for each offered disconnector and earthing switch design

Table C1: Material and Corrosion Protection Information

This information is required to be completed by the Supplier for each offered disconnector and earthing switch design type		
Eskom Transmission specified requirements	To be completed by the Supplier	Completed Example (guide by Eskom)
Item or part Description		<i>Support bracket</i>
Drawing number		<i>DEMO1</i>
Material type		<i>EN8</i>
Material grade		<i>(BS 970 080M40)</i>
Type of corrosion protection		<i>HD galvanising</i>
Minimum thickness of protective coating		<i>85 micro</i>
Verification tests carried out on coating e.g. Thickness with thickness gauge		<i>6 measurements along profile</i>
Expected life of coating (Industry/marine)		<i>Marine = 5 years Industry = 8 years</i>
Maintenance frequency of protection coating		<i>Repair installation damage on commissioning and thereafter once a year</i>
Maintenance type of protection coating		<i>Patch repair with Zincfix</i>
Bi-metallic corrosion prevention		<i>Coat both sides</i>
Crevice corrosion prevention		<i>Seal with crevice with Zincfix</i>
Item or part weight in Kilogram		<i>7kg</i>
Field experience		<i>Equipment used at coast in</i>
Remarks/General comments		<i>Debris, scratches and indentation have been removed prior to galvanising.</i>

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Annex D – Drawings – Outline and General Arrangement

This section shall be read in conjunction with this standard specification's Drawings (refer to subclause 3.2.25) and Documentation Requirements (refer to subclause 3.2.26).

Table D2: Eskom Transmission standard drawings for outdoor disconnectors and earthing switches steel support structures which are in line with Eskom Transmission civil foundations

System voltage [kV]	Spacing [mm]	Eskom Tx steel support Top Cap drawing number	Eskom Tx steel support structure drawing number	Disconnector or earthing switch	OEM GA drawing number	Wiring drawing number
22	1 000	NOTE: Drawing sets to be prepared by Supplier as per this phase spacing, for Hand Operated disconnectors (with and without earthing switches).				
		0.54/306 or 0.54/307	0.54/8829	Disconnector without earthing switch		
		0.54/306 or 0.54/307	0.54/8829	Disconnector – with LH earthing switch		
		0.54/306 or 0.54/307	0.54/8829	Disconnector – with RH earthing switch		
		0.54/306 or 0.54/307	0.54/8829	Disconnector – with Double earthing switch		
33 (also used on FACTS busbars (Live-chamber))	1 200	NOTE: Drawing sets to be prepared by Supplier as per this phase spacing, for Hand Operated disconnectors (with and without earthing switches) and for Motor Operated disconnectors of 110 VDC and 220 VDC (with and without earthing switches). Also the drawings for the separately mounted earthing switches shall be of these two phase spacings.				
		0.54/306 or 0.54/307	0.54/8829	Disconnector without earthing switch		
		0.54/306 or 0.54/307	0.54/8829	Disconnector – with LH earthing switch		
		0.54/306 or 0.54/307	0.54/8829	Disconnector – with RH earthing switch		
		0.54/306 or 0.54/307	0.54/8829	Disconnector – with Double earthing switch		
		0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch		
66 (also used on 44 kV network)	2 000	NOTE: Drawing sets to be prepared by Supplier as per this phase spacing, for Hand Operated disconnectors (with and without earthing switches) and for Motor Operated disconnectors of 110 VDC and 220 VDC (with and without earthing switches). Also the drawings for the separately mounted earthing switches shall be of these two phase spacings.				
		0.54/306 or 0.54/307	0.54/8829	Disconnector without earthing switch (0ES)		
		0.54/306 or 0.54/307	0.54/8829	Disconnector – with LH earthing switch (1ES – LH)		
		0.54/306 or 0.54/307	0.54/8829	Disconnector – with RH earthing switch (1ES – RH)		

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SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED SWITCHGEAR RATED FOR VOLTAGES 1 KV AND ABOVE – OUTDOOR DISCONNECTORS AND EARTHING SWITCHES

Unique Identifier: **240-180000569**Revision: **1**Page: **82 of 91**

System voltage [kV]	Spacing [mm]	Eskom Tx steel support Top Cap drawing number	Eskom Tx steel support structure drawing number	Disconnecter or earthing switch	OEM GA drawing number	Wiring drawing number
		0.54/306 or 0.54/307	0.54/8829	Disconnecter – with Double earthing switch (2ES)		
		0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch		

132 (also used on 88 kV network)	2 400 /	NOTE: Drawing sets to be prepared by Supplier as per these two phase spacings, for Hand Operated disconnectors (with and without earthing switches) and for Motor Operated disconnectors of 110 VDC and 220 VDC (with and without earthing switches). Also the drawings for the separately mounted earthing switches shall be of these two phase spacings.				
	3 000	0.54/306 or 0.54/307	0.54/8829	Disconnecter without earthing switch (0ES)		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter – with LH earthing switch (1ES LH)		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter – with RH earthing switch (1ES RH)		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter – with Double earthing switches (2ES)		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/Tubular) (0ES) – 2 150 mm high		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/Tubular) (1ES) – SES – 2 150 mm high		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/Tubular) (0ES) – SES – 2 500 mm high		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/Tubular) (1ES) - SES - 2500 mm high		
		0.54/306 or 0.54/307	0.54/6109	Disconnecter pantograph (Twin/Tubular) (0ES) - SES - 3000 mm high		
		0.54/306 or 0.54/307	0.54/6109	Disconnecter pantograph (Twin/Tubular) (1ES) - SES 3 000 mm HIGH		

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**Revision: **1**Page: **83 of 91**

		0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch – 2 400 mm spacing		
		0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch – 3 000 mm spacing		
			Supplier's scope of Supply	Disconnecter bottom base horizontal cross-beam – 2 400 mm spacing		
			Supplier's scope of Supply	Disconnecter bottom base horizontal cross-beam – 3 000 mm spacing		
			Supplier's scope of Supply	Trapeze assembly with its connecting- ware, Adaptor plates required to mount		

275 (also used on 220 kV network)	4 300 /	NOTE: Drawing sets to be prepared by Supplier as per these three phase spacings. Also the drawings for separately mounted earthing switches shall be of these three phase spacings.				
	5 500 /	0.54/306 or 0.54/307	0.54/8829	Disconnecter without earthing switch (0ES)		
	6 700	0.54/306 or 0.54/307	0.54/8829	Disconnecter – with LH earthing switch (1ES LH)		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter – with RH earthing switch (1ES RH)		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter – with Double earthing switches (2ES)		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/ Tubular) (0ES) – 2 150 mm high		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/ Tubular) (1ES) – SES – 2 150 mm high		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/ Tubular) (0ES) – SES – 2 500 mm high		

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**Revision: **1**Page: **84 of 91**

	0.54/306 or 0.54/307	0.54/8829	Disconnector pantograph (Twin/ Tubular) (1ES) - SES – 2 500 mm high		
	0.54/306 or 0.54/307	0.54/6109	Disconnector pantograph (Twin/ Tubular) (0ES) - SES - 3 000 mm high		
	0.54/306 or 0.54/307	0.54/6109	Disconnector pantograph (Twin/ Tubular) (1ES) - SES 3 000 mm HIGH		
	0.54/306 or 0.54/307	0.54/6109	Disconnector pantograph (Twin/ Tubular) (0ES) - SES - 3 500 mm high		
	0.54/306 or 0.54/307	0.54/6109	Disconnector pantograph (Twin/ Tubular) (1ES) - SES 3 500 mm HIGH		
	0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch – 4 300 mm spacing		
	0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch – 5 500 mm spacing		
	0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch – 6 700 mm spacing		
		Supplier's scope of Supply	Disconnector bottom base horizontal cross-beam – 4 300 mm spacing		
		Supplier's scope of Supply	Disconnector bottom base horizontal cross-beam – 5 500 mm spacing		
		Supplier's scope of Supply	Disconnector bottom base horizontal cross-beam – 6 700 mm spacing		
		Supplier's scope of Supply	Trapeze assembly with its connecting- ware, Adaptor plates required to mount operating drive, interconnecting pipes, etc. -etc.		

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**Revision: **1**Page: **85 of 91**

400 (also used on 550 kV rated circuit- breakers)	5500 /	NOTE: Drawing sets to be prepared by Supplier as per these three phase spacings. Also the drawings for separately mounted earthing switches shall be of these three phase spacings.				
	6500 /	0.54/306 or 0.54/307	0.54/8829	Disconnecter without earthing switch (0ES)		
	7010	0.54/306 or 0.54/307	0.54/8829	Disconnecter – with LH earthing switch (1ES LH)		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter – with RH earthing switch (1ES RH)		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter – with Double earthing switches (2ES)		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/ Tubular) (0ES) – 2 150 mm high		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/ Tubular) (1ES) – SES – 2 150 mm high		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/ Tubular) (0ES) – SES – 2 500 mm high		
		0.54/306 or 0.54/307	0.54/8829	Disconnecter pantograph (Twin/ Tubular) (1ES) - SES – 2 500 mm high		
		0.54/306 or 0.54/307	0.54/6109	Disconnecter pantograph (Twin/ Tubular) (0ES) - SES - 3 000 mm high		
		0.54/306 or 0.54/307	0.54/6109	Disconnecter pantograph (Twin/ Tubular) (1ES) - SES 3 000 mm HIGH		
		0.54/306 or 0.54/307	0.54/6109	Disconnecter pantograph (Twin/ Tubular) (0ES) - SES - 3 500 mm high		
		0.54/306 or 0.54/307	0.54/6109	Disconnecter pantograph (Twin/ Tubular) (1ES) - SES 3 500 mm HIGH		
		0.54/306 or 0.54/307	0.54/6109	Disconnecter pantograph (Twin/ Tubular) (0ES) - SES - 4 000 mm high		

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**
Unique Identifier: **240-180000569**Revision: **1**Page: **86 of 91**

400		0.54/306 or 0.54/307	0.54/6109	Disconnecter pantograph (Twin/ Tubular) (1ES) - SES 4 000 mm HIGH		
		0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch – 5 500 mm spacing		
		0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch – 6 500 mm spacing		
		0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch – 7 010 mm spacing		
			Supplier's scope of Supply	Disconnecter bottom base horizontal cross-beam – 5 500 mm spacing		
			Supplier's scope of Supply	Disconnecter bottom base horizontal cross-beam – 6 500 mm spacing		
			Supplier's scope of Supply	Disconnecter bottom base horizontal cross-beam – 7 010 mm spacing		
			Supplier's scope of Supply	Trapeze assembly with its connecting- ware, Adaptor plates required to mount operating drive, interconnecting pipes, etc. -etc.		

765	11 000 /	NOTE: Drawing sets to be prepared by Supplier as per these three phase spacings. Also the drawings for separately mounted earthing switches shall be of these two phase spacings				
	14 000	0.54/306 or 0.54/307	TBA	Disconnecter without earthing switch (0ES)		
		0.54/306 or 0.54/307	TBA	Disconnecter – with LH earthing switch (1ES LH)		
		0.54/306 or 0.54/307	TBA	Disconnecter – with RH earthing switch (1ES RH)		
		0.54/306 or 0.54/307	TBA	Disconnecter – with Double earthing switches (2ES)		
		0.54/306 or 0.54/307	0.54/8829	Separately mounted earthing switch – 11 000 mm spacing		
		0.54/306 or 0.54/307	TBA	Separately mounted earthing switch – 14 000 mm spacing		

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**

Revision: **1**

Page: **87 of 91**

			Supplier's scope of Supply	Disconnecter bottom base horizontal cross-beam – 11 000 mm spacing		
			Supplier's scope of Supply	Disconnecter bottom base horizontal cross-beam – 14 000 mm spacing		
			Supplier's scope of Supply	Connecting flexible conductor, Adaptor plates required to mount operating drive, interconnecting pipes, etc. -etc.		

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Annex E – Switchgear Training requirements from OEM

1. Switchgear Training from Suppliers and their OEM's

With respect to switchgear training for Eskom Transmission (Tx), it seeks to address skills upon various challenges experienced with the installation, testing commissioning, operating, maintenance, failure conditions and intrusive maintenance and repairs of switchgear equipment. This aims to positively impact the entire life cycle stages of switchgear plant, ensuring that it stays in service as per designed life expectancy. The trained Eskom Transmission switchgear personnel working on the equipment shall not negatively impact the warranty of the switchgear.

This is an Eskom Transmission standard training approach that all contracted Suppliers and their OEM's for switchgear are required to comply with, together with the development of the standardized training material.

This addresses the standardized approach to switchgear training from Switchgear Suppliers and Original Equipment Manufacturers (OEM's), and provides clarity to what it entails.

1.1 General Training Requirements

- a. The Supplier and its OEM shall provide the OEM accredited instructors to give first-hand training of an international standard on the supplied equipment, and where applicable, including the electronic digital online condition monitoring and/or integrated diagnostic devices. For new contracts, a switchgear unit of the first delivery (installation) at the Grid shall be targeted by the Supplier and their OEM to provide local non-intrusive switchgear technical training within the contractual lead time, for training and quality assurance purposes. This shall form part of tender submission for switchgear contracting.

However, for switchgear intrusive specialized training, that can be conducted at the OEM factory, with details submitted to Eskom Transmission upfront during tender submission. The pre-requisite for the higher-level training shall be the successful completion of the preceding level.

- b. Switchgear training material written in English, shall be developed by the Supplier and their OEM, and submitted for approval by Eskom Transmission switchgear Task Team and Care group. This material shall be done in accordance with the offered Eskom Transmission specified switchgear.
- c. The Supplier shall provide electronic digital online condition monitoring and/or integrated diagnostic devices training as a line item on the contract. This training shall cover the design, application, operation, settings, commissioning and maintenance of the device, including any applicable software.
- d. There shall be a training for the offered digital online condition monitoring and/or integrated diagnostic before the Factory Acceptance Testing.
- e. The training and training material shall comprise installation, testing and non-intrusive condition-based maintenance as part of switchgear contract and shall be provided in English.
- f. Training shall be made available for the life cycle of the switchgear.
- g. The intrusive training (major maintenance internal inspection and repairs upon breakdown) shall be available between the Supplier and OEM when requested by Eskom Transmission, even though this is not part of the switchgear contract phase.
- h. Training shall consist of the following:
 - 1) Approximately 30% theoretical training and theoretical examinations thereof.
 - 2) Approximately 70% practical training and the practical examinations thereof.

1.2 Non-intrusive switchgear technical training (Install, Tests, Maintenance and Trouble-shooting)

1.2.1 Description

Training for Eskom Transmission Grid personnel responsible for all aspects of installation, testing, commissioning, breakdown repairs maintenance and scheduled maintenance of switchgear and associated components.

1.2.2 Costs

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This training and training material development shall be free issued with the disconnector and earthing switch, and where applicable the surge capacitor. To manage the costs, it shall be deployed by the Supplier and OEM factory during the first installation per South African provincial boundary of CLN's of Eskom Transmission.

1.2.3 Course content covers

The training course content shall cover the following topics:

1.2.3.1 Erection/installation and commissioning testing, and condition-based maintenance inspection

a) Objective

After attending this course, the person(s) will be accredited/certified to install, set, commission and maintain the equipment(s).

b) Duration

As per Supplier and its OEM requirements.

c) Location

Eskom Transmission and Supplier with its OEM shall agree on the location. (This must be stated in the contract.). As part of training rollout during the contract period, Eskom Transmission shall make necessary arrangements for an agreed training venue in consultation with targeted audience.

d) Frequency

To be negotiated as part of the contract. This shall be a once-off training course per trainee. Re-assessment frequency shall be as per OEM requirement.

e) Course content

To be prepared by the local Supplier and the OEM factory then submitted to Eskom Transmission to ensure it meets the Learning and Development (L&D) requirements. Eskom Transmission shall approve the final revision and sign-off the copy that will be shared with Supplier.

f) Target group

- Grid Switchgear Maintenance Specialists
- Technical Support – Grid HV Plant Technical/ Engineering personnel
- Asset Management (SED) Switchgear Equipment Specialists

1.2.3.2 Electronic digital online condition monitoring and/or integrated diagnostic device – setting (configuring), installation, commissioning, testing and breakdown maintenance (troubleshooting), minor maintenance (non-intrusive, visual inspection)

a) Objective

After attending this course, the person(s) will be accredited/certified to set-up the electronic digital online condition monitoring and/or integrated diagnostic devices, installation and commissioning testing the disconnector and earthing switch including all tests confirming correct functionality.

b) Duration

As per Suppliers and its OEM requirements.

c) Location

Eskom Transmission and Supplier with its OEM shall agree on the location, since this will be for disconnectors and earthing switches with electronic digital online condition monitoring and/or integrated diagnostic devices, of where it has been ordered separately. (This must be stated in the contract.). As part of training rollout during the contract period, Eskom Transmission shall make necessary arrangements for an agreed training venue in consultation with targeted audience.

d) Frequency

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This shall be a once-off training course per trainee attended. Assessment for accreditation shall be as per OEM requirement.

e) Course content

To be prepared by the local Supplier and the OEM factory then submitted to Eskom Transmission to ensure it meets the Learning and Development (L&D) requirements. Eskom Transmission (Tx) PTM&C representatives switchgear care group and Switchgear Task Team, shall approve the final revision and sign-off the copy that will be shared with Supplier.

f) Target group

- Grid Secondary Plant (Test department representatives), and
- Engineering PTM&C (Design Application and Technology)
- System Operations (Secondary Plant Operations and Investigations)

1.2 Intrusive switchgear technical training (Major Maintenance and Repairs)

1.2.1 Description

Training and accreditation on intrusive internal maintenance inspection and repairs (overhauling upon breakdown) of switchgear [Also referred to as Major Overhaul Task (MOT) or Major Maintenance]. This training shall be for Eskom Transmission Grid personnel responsible for all intrusive breakdown repairs maintenance and scheduled major maintenance of switchgear and associated components.

1.2.2 Costs

This training and training material development shall be for the disconnector and earthing switch, and where applicable the surge capacitor. The costs implications discussions shall be handled by Eskom Transmission and the Supplier.

1.2.3 Course content covers

The training course content shall cover the following topics:

1.2.3.1 Erection, commissioning, testing, breakdown maintenance (troubleshooting), minor maintenance (non-intrusive, visual inspection)

g) Name of training programme

Major Maintenance/Corrective Maintenance (Intrusive, servicing of equipment).

h) Objective

After attending this course, the person(s) will be accredited/certified to execute breakdown maintenance, minor maintenance and testing (mechanical, electrical and gas analysis or insulation medium analysis).

The OEM factory accredited Trainer will visit the Eskom Transmission accredited/certified Grid Switchgear Maintenance Specialists upon the factory specified validity of their certification/ accreditation nears expiry and requires renewal;

i) Duration

Training to be provided as and when required.

j) Location

This training and training material development shall be for the disconnector and earthing switch, and where applicable the surge capacitor. The location details discussions shall be handled by Eskom Transmission and the Supplier.

k) Purpose

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**SPECIFICATION FOR HIGH VOLTAGE AIR INSULATED
SWITCHGEAR RATED FOR VOLTAGES 1 KV AND
ABOVE – OUTDOOR DISCONNECTORS AND EARTHING
SWITCHES**

Unique Identifier: **240-180000569**

Revision: **1**

Page: **91 of 91**

After attending this course, the person(s) will be accredited/certified to perform intrusive maintenance and conduct training (non-intrusive Level).

l) Frequency

This shall be a once-off training course per trainee attended (Grid Switchgear Maintenance Specialist.). Assessment for accreditation shall be as per OEM requirement. Reassessment shall be as per OEM requirement.

m) Course content

To be prepared by the local Supplier and the OEM factory then submitted to Eskom Transmission to ensure it meets the Learning and Development (L&D) requirements. Eskom Transmission (Tx) switchgear care group and Switchgear Task Team, shall approve the final revision and sign-off the copy that will be shared with Supplier.

n) Target group

- Grid Switchgear Maintenance Specialist that performs maintenance and breakdown repairs;
- Asset Management (SED) Switchgear Equipment Specialists