

 Eskom	Standard	Technology
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Title: **HIGH VOLTAGE OUTDOOR
DISCONNECTORS AND
EARTHING SWITCHES
STANDARD**

Unique Identifier: **240-56063815**

Alternative Reference Number: **<n/a>**

Area of Applicability: **Engineering**

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COE Acceptance



Bheki Ntshangase

**Senior Manager Substation Equipment &
Diagnostics, Transmission**

Date: 9/04/2021

DBOUS Acceptance



Amelia Mtshali

Senior Manager DBOUS, Distribution

Date: 09/04/2021

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1	A specific plant, project or solution	X
2	A mature and stable technical area/technology	
3	Established and accepted practices.	

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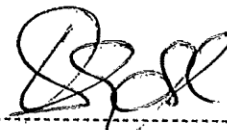
Isaac Sibeko
Senior Engineer

Approved by



Jabulani Cebekhulu
AIS Care Group Convener

Authorized by



Bheki Ntshangase
Senior Manager HV Plant

Date: 8/12/2015

Date: 8/12/2015

Date: 10/12/2015

Supported by SCOT/SC



Bheki Ntshangase
SCOT/SC Chairperson

Date: 10/12/2015

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1. Introduction

This standard covers Eskom's specific and standard requirements for outdoor alternating current disconnectors and earthing switches from 11 kV up to and including 765 kV system voltage levels. 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.

The equipment specified herein will be used on the Eskom's Transmission and Distribution's 50 Hz AC high voltage system for purposes of safety isolation, safety earthing and circuit selection.

This standard is based on SANS 62271-102: Alternating current disconnectors and earthing switches.

2. Supporting clauses

2.1 Scope

2.1.1 Purpose

This standard covers Eskom's technical requirements for high-voltage outdoor disconnectors and earthing switches for voltages above 1 000V. It provides the specific and standardised requirements. This standard 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 specification addresses design, manufacture, testing, supply, delivery, erection, pre-commission testing, operation and maintenance training of outdoor type disconnectors, earthing switches and associated equipment specified herein. The disconnectors and earthing switches shall comply with SANS 62271-102 and the additional and special requirements mentioned in this standard.

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

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

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/informative references

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

NOTE: When issuing an enquiry based on this standard, it should be stated in the enquiry that the editions of the normative references that are current at the date of issue of the enquiry shall apply, unless otherwise agreed with Eskom. However in special cases, the responsible engineer may rule that the editions of one or more normative references applicable at the effective date of the Eskom specification shall apply

2.2.1 Normative

- [1] SANS 62271-102, Alternating current disconnectors and earthing switches.
- [2] SANS 62271-1, Common clauses for high-voltage switchgear and control gear standards.
- [3] SANS 60529, Degrees of protection provided by enclosures (IP code).
- [4] SANS 60137, Insulated bushings for alternating voltages above 1 000 V.
- [5] SANS 60265-1, High-voltage switches – Part 1: Switches for rated voltages above 1 kV and less than 52 kV.

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- [6] SANS 62271-104, High-voltage switches – Part 2: High-voltage switches for rated voltages of 52 kV and above.
 - [7] SANS 60273, Characteristics of indoor and outdoor post insulators for systems with nominal voltages greater than 1 000 V
 - [8] SANS 60168, Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1 000 V
 - [9] SANS 60815, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions Part 1: Definitions, information and general Principles
 - [10] SANS 60815, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions Part 2: Ceramic and glass insulators for ac systems
 - [11] SANS 62262, Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
 - [12] SANS 62271-301, Dimensional standardisation of high-voltage terminals
 - [13] Occupational Health and Safety Act (OHS Act) No. 85 of 1993 – Construction and Electrical Machinery Regulations.
 - [14] SANS 121 (ISO 1461) Hot-dip galvanised coatings on fabricated iron and steel articles – Specifications and test methods.
 - [15] SANS 1019, Standard voltages, currents and insulation levels for electricity supply.
 - [16] SANS 1091, National colour standard.
 - [17] ESP 32-846: Operating Regulations for High Voltage Systems (ORHVS)
 - [18] QM-58, Supplier contract quality requirements specification
 - [19] TPC41-141: Commissioning of new substation plant documentation and check sheets.
 - [20] 240-75655504, Corrosion protection specification for new indoor and outdoor Distribution equipment manufactured from steel.
 - [21] 240-56065202, Switchgear training requirements from original equipment manufacturers.
 - [22] 240-56062328: Rev 0 KIPTS natural ageing and pollution performance test procedure for outdoor insulator products Section 0 – General Requirements
 - [23] 240-56062330: Rev 0 KIPTS natural ageing and pollution performance test procedure for outdoor insulator products Section 4 – Particular requirements for Switch Disconnectors
 - [24] Technical Bulletin: 06TB-027: CAP's Requirements for KIPTS Test reports
 - [25] 240-89286480, Proposed HV linked isolator (three pole) auxiliary switch (secondary) contact arrangements
 - [26] D-DT 5200: Substation standard drawing-foundations and structural supports
 - [27] D-DT 6000: Buyers Guide - substation
 - [28] 0.54/07129: Outdoor application earth switch 220, 275, 400 & 765kV standard terminal numbering
 - [29] 0.54/07858: Outdoor application isolator 220, 275, 400kV & 765 kV standard terminal numbering
 - [30] 0.54/07859: Outdoor application isolator 132kV and below standard terminal numbering
 - [31] 0.54/07860: Outdoor application earth switch 22- 132kV standard terminal numbering
 - [32] 0.54/07861: Outdoor application isolator pantograph 220, 275, 400 & 765kV standard terminal numbering
 - [33] 0.54/3987: 400kV three phase bus bar isolator support (5,5m phase centres)
 - [34] 0.54/3558: 400kV three phase bus bar earthing switch support tubular substation

2.2.2 Informative

None

2.3 Definitions**2.3.1 General**

For the purposes of this standard and clause 3 of SANS 62271-1, the following terms, definitions and abbreviations are applicable:

Definition	Description
Disconnecter	A mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements. 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.
Disconnecter terminology	It is equivalently used in this standard for isolators, links, pantograph, semi pantograph and knee type designs.
Earthing switch	A 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.
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.
The definitions given in SANS 62271-100 and the following shall apply:	
Breakdown maintenance	Unplanned (or unscheduled) maintenance work required to repair a fault and thus restore the switchgear and control gear to an acceptable condition after a failure.
Major maintenance (overhaul)	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 control gear to an acceptable condition (within tolerance). NOTES 1) This is the definition of "overhaul" given in 3.1.11 of SANS 62271-1. 2) Major maintenance involves the execution of specialised maintenance where specialised knowledge and skills are required and is also sometimes referred to as specialised maintenance.

Definition	Description
Minor maintenance	<p>The execution of scheduled or preventive maintenance work in accordance with the manufacturer's maintenance manual and requiring the switchgear and control gear to be taken out of service (i.e. in a down state).</p> <p>NOTES</p> <ol style="list-style-type: none"> 1) Observations resulting from minor maintenance can lead to the decision to carry out an overhaul. 2) Scheduled maintenance is defined in 3.1.7 of SANS 62271-1. 3) Minor maintenance may be time-based and/or condition-based. 4) Minor maintenance may also include <i>switchgear</i> examination (refer to 3.1.10 of SANS 62271-1) with diagnostic tests (refer to 3.1.9 of SANS 62271-1). 5) Minor maintenance may also be referred to as 2nd line maintenance.
Routine inspection	<p>Visual investigation of the principal features of the switchgear and control gear in service without dismantling.</p> <p>NOTES</p> <ol style="list-style-type: none"> 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 control gear in service are also included. 2) Observations resulting from inspection can lead to the decision to carry out an overhaul. 3) As indicated in note 1 above, routine inspection may include scheduled maintenance activities in accordance with the manufacturer's maintenance manual. 4) Routine inspection may also be referred to as 1st line maintenance. 5) This is the definition of "inspection" given in 3.1.8 of SANS 62271-1.
Specialised tools	Purposely designed tools that are necessary to carry out maintenance on a disconnector and/or earthing switch. Typical examples of such tools are jigs for contact assembly and/or contact pressure, mechanical bearing assembly and disassembly, etc.
Working clearance	Straight line distance (clearance) from the closest live part at service voltage to ground level required to safely conduct work.

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
Disconnector class M1	Disconnector having an extended mechanical endurance of 2 000 operating cycles
Disconnector class M2	Disconnector having an extended mechanical endurance of 10 000 operating cycles
OEM	Original Equipment Manufacturer
ORHVS	Operating Regulations for High Voltage Systems

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Abbreviation	Description
PVC	Poly Vinyl Chloride
RIV	Radio Influence Voltage
SPS class	Site Pollution Severity class

2.5 Roles and responsibilities

PDE HV Plant Engineering shall ensure that the approved standard is in place for use by Eskom.

The detailed list of Supplier and Eskom responsibilities are covered under Clause 3.46.2 and 3.47.

2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

Technical schedules A & B.

3. Service Conditions

The normal service conditions for outdoor switchgear and control gear specified in SANS 62271-1 shall apply. The following additional specific requirements shall be taken into account:

- a) Ambient temperatures ranging from -10 °C to +45 °C. Sudden and drastic temperature changes are encountered with the resulting condensation of water vapour that can take place within housings, mechanism boxes and hollow components.
- b) Solar radiation intensity up to a level of 1100 W/m² as well as significant ultra-violet (UV) radiation intensity.
- c) The altitude does not exceed 1800 m. De-rating effects due to lower air density in terms of dielectric withstand, Radio Influence Voltage (RIV) behaviour and continuous current handling capability up to an altitude of 1 800 m above sea level.
- d) 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 corrosion characterizing the site severity will be specified in Schedule A in accordance and the details required under clause 3.20.3 shall be supplied with tender documentation.
- e) Mechanical forces due to wind and overhead conductor loadings up to a maximum continuous value of 1500 N in any direction imposed on the main terminals.
- f) Wind pressure: not exceeding 700 Pa (equivalent to 34 m/s)
- g) Unusual service conditions, example, abnormal vibration, shocks, earthquakes, or tilting and or seismic activity up to 0, 3 g.

4. Ratings

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.

4.1 Rated Voltage (U_r)

The rated maximum voltage of a switch is the highest root-mean-square (rms) line-to-line voltage of rated power frequency for which the switch is designed to operate.

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The rated voltage of the disconnectors shall be in accordance with the values given in section 1. The rated voltage will be specified in schedule A. The rated voltage offered shall be stated in schedule B.

Note: The nominal system voltages in Eskom's are 11 kV, 22 kV, 33 kV, 66 kV, 88kV, 132 kV, 220 kV, 275 kV, 400 kV and 765 kV. For 88kV system, the 132kV disconnectors and earthing switches are used.

4.2 Rated Insulation Level

The rated insulation levels of the disconnectors shall be in accordance with the values given in Table 1 and shall be stated in schedule B.

Table 1: Rated insulation levels for rated voltages

Rated voltage for equipment U_r [kV] r.m.s.	Nominal system Voltage U_n [kV] r.m.s.	Rated short-duration power frequencies withstand voltage U_d [kV] r.m.s.		Rated lightning impulse withstand peak voltage U_p [kV]		Rated switching impulse withstand peak voltage U_s [kV]		
		Common value	Across the isolating distance	Common value	Across the isolating distance	Phase-to- earth and across open switching device	Between phases	Across isolating distance
12	11	28	32	75	85	N/A	N/A	N/A
24	22	50	60	125	145	N/A	N/A	N/A
36	33	70	80	170	195	N/A	N/A	N/A
52	44	95	110	250	290	N/A	N/A	N/A
72,5	66	140	160	325	375	N/A	N/A	N/A
100	88	185	210	450	520	N/A	N/A	N/A
145	132	230 275	265 315	550 650	630 750	N/A	N/A	N/A
245	220	360 395	415 460	815 950	950 1 050	N/A	N/A	N/A
300	275	395	435	950 1050	950+(170) 1050+(170)	750 850	1 125 1 275	700 + (245)
362		450	520	1050 1175	1 050(+205) 1 175(+205)	850 950	1275 1 425	800(+295)
420	400	520	610	1 425	1425+(240)	1 050	1 575	900 +(345)
550	400	620	800	1550	1550 (+315)	1050	1175	900 (+450)
800	765	960	1 150	2 100	2100+(455)	1 425	2 420	1175 +(650)

The information in this Table is extracted from SANS 1019 and SANS 62271-1 with correction applied for Eskom requirements. These values represent Eskom's minimum requirements.

4.3 Rated Frequency

The rated power frequency is the fundamental steady-state supply voltage frequency at which the switch is designed to operate. The rated frequency of disconnectors and earthing switches shall be 50 Hz.

4.4 Rated Normal Current and Temperature Rise

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

The specific rated normal current of disconnectors shall be 1600 A; 2500 A; 3150 A and 4000 A and clause 4.4 of and SANS 62271-1 is applicable.

The rated normal current shall be specified in schedule A. The tenderer shall state the rated normal current offered in schedule B. The associated temperature and temperature rise limits shall be in accordance with the and SANS 62271-1.

Table 2: Rated values of normal current (I_r), short-time withstand current (I_k) and peak withstand current (I_p)

Rated Voltage (U_r) [kV]	Rated normal current (I_r) [A]					Rated short- time withstand current (I_k) [kA]	Rated peak withstand current (I_p) [kA]
	1600	2000	2500	3150	4000		
12	x	x	x	-	-	20 / 25	50 / 63
24	x	-	x	-	-	20 / 25 / 31.5	50 / 63 / 80
36	x	x	x	-	-	20 / 25 / 31.5	50 / 63 / 80
52	x	x	x	-	-	20 / 25 / 31.5	50 / 63 / 80
72,5	x	x	x	x	-	20 / 25 / 31.5	50 / 63 / 80
100	x	-	x	-	-	20 / 25/40	50 / 63/100
145	x	x	x	x	-	20 / 25 / 40	50 / 63 / 100
245	-	-	x	x	-	40 / 50	100 / 125
300	-	-	-	x	-	50	125
420	-	-	-	x	x	50 / 63	125 / 160
550	-	-	-	x	x	50 / 63	125 / 160
800	-	-	-	x	x	50	125

4.5 Rated Short Time Withstand Current (I_k)

The rated short-time withstand current shall be as sub clause 4.5 of SANS 62271-1 with the following addition, for Eskom requirements refer to [Table 2](#). If an earthing switch is combined with a disconnector as a single unit, the rated short-time withstand current of the earthing switch shall, unless otherwise specified, be at least equal to that assigned to the disconnector.

The rated short-time current shall be stated in schedule A. The tenderer shall state the rated short-time current offered in schedule B and time period.

4.6 Rated Peak Withstand Current (I_p)

Sub clause 4.6 of SANS 62271-1 is applicable with the following addition, for Eskom requirements refer to [Table 2](#).

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

The rated peak withstand current shall be stated in schedule A. The tenderer shall state the rated peak withstand current offered in schedule B.

4.7 Rated Duration of Short-circuit (t_k)

The rated duration of short-circuit shall be 3 seconds and sub-clause 4.6 of SANS 62271-1 is applicable with the following addition:

If an earthing switch is combined with a disconnector as a single unit, 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 disconnector.

4.8 Rated Supply Voltage of Closing and Opening Devices and of Auxiliary and Control Circuits (U_a)

Sub clause 4.8 of SANS 62271-1 is applicable; limit is covered in schedule A.

4.9 Rated Supply Frequency of Closing and Opening Devices and of Auxiliary Circuits

Sub clause 4.9 of SANS 62271-1 is applicable.

4.10 Ice Breaking Capability

The rated ice breaking capability shall be stated in schedule B.

Notwithstanding the fact that the operating environment is not conducive to severe icing conditions, mechanical strength reserves and safety factors of the equipment shall be satisfactorily demonstrated by having successfully passed an ice-breaking test according to SANS 62271-102 Clause 6.103 for a Class 10 category.

4.11 Rated Short-circuit Making Current

Earthing switches to which a rated short-circuit making current has been assigned shall be capable of making at any applied voltage, up to and including that corresponding to their rated voltage, any current up to and including their rated short-circuit making current.

If an earthing switch has a rated short-circuit making current, this shall be equal to the rated peak withstand current.

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

4.12 Rated Contact zone

The rated values of contact zone shall be obtained from the manufacturer. This refers also to a tolerable angular displacement of the fixed contact. For proper function of the disconnector or earthing switch, the user shall ensure that the fixed contact stays within these limits by considering the service conditions when specifying the substation design and the cantilever strength of insulators

4.13 Rated Mechanical Terminal Load

The rated mechanical terminal load shall be stated by the manufacturer in accordance with SANS 62271-102. This shall be stated in schedule B.

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 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.

Recommended rated static mechanical terminal loads are given in table 3 of SANS 62271-102 and are intended to be used as a guide.

Rated Values of the Bus-transfer Current Switching Capability of Disconnectors

This sub clause is applicable to disconnectors rated 52 kV and above. The tenderer 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 80 % of the rated normal current. It will normally not exceed 1 600 A, irrespective of the rated normal current of the disconnector.

NOTE: A maximum rated bus-transfer current of 1 600 A was chosen as being typically the highest current which can be switched even though the rated normal current of the disconnector may be substantially greater. It is common practice to select disconnectors based on the short-time current ratings as well as the rated normal current. The maximum continuous current carried by the disconnector, therefore, may be considerably less than the rated normal current. Rated bus-transfer currents greater than 80 % of the rated normal current or greater than 1 600 A may be assigned by the manufacturer.

4.14 Rated Values of the Induced Current Switching Capability of Earthing Switches

This sub clause is applicable to disconnectors rated 52 kV and above. The tenderer shall state the rated value of the induced current switching capability in schedule B.

4.15 Rated Values of Mechanical Endurance for Disconnectors

A disconnector shall be able to perform the following number of operations taking into account the programme of maintenance specified by the manufacturer. Eskom shall specify the required mechanical endurance class of the disconnector in schedule A.

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

Table 3: Classification of disconnectors for mechanical endurance

Class	Type of disconnector	Number of operating cycles
M1	Disconnector intended for use with a circuit breaker of equal class (extended mechanical endurance)	2 000
M2	Disconnector intended for use with a circuit breaker of equal class (extended mechanical endurance)	10 000

4.16 Rated Values of Electrical Endurance for Earthing Switches

Earthing switches have three classes of electrical endurance:

- earthing switches with no making capability = class E0;
- earthing switches with short-circuit making capability = class E1 (these earthing switches have the making capability of two making operations);
- earthing switches with a short-circuit making capability of five making operations = class E2;
- Eskom shall specify the required electrical endurance class of the disconnector in schedule A.
- The tenderer shall state the electrical endurance class of the disconnector in schedule B.

5. Design and Construction

5.1 Requirements

5.1.1 Design, Component and Material Changes

NOTE: For the duration of the contract and also applicable to once off orders, no changes shall be made to the equipment as well as the officially approved drawings. If such changes are unavoidable, agreement to such changes require written approval by the Commodity Manager (refer to QM-58 specification)

In the event of changes to the equipment, the change(s), together with the reasons for wishing to make the change, shall be forwarded to the Commodity Manager. All concessions shall be approved by Eskom.

In the case that changes are required, a modification instruction with pictures, drawings and measurements shall be provided.

Suitable training and parts shall be supplied to Eskom within 30 days of any modification required for all disconnectors and earthing switches supplied to Eskom.

- a) The handling of all defects shall be referred to the commercial rules of the contract.
- b) Life expectancy of the equipment shall be to the type tested values of the design, mechanical and electrical endurances but is expected to be not less than 40 years when operating at least twice per day.

5.1.2 Type of Disconnector

The type of disconnector, e.g. conventional or pantograph shall be as specified in schedule A. The tenderer 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 tenderer 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.
- e) All disconnectors shall have type tested and proven dead centre or over-locking method.

5.1.3 Adjustment Facilities and Stability of Settings

- a) At points where stable and fine adjustment is necessary to achieve correct functional behaviour this must 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 disconnector.

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 bid 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.

5.2 Earthing Switches

5.2.1 Type of Earthing Switch

The number and type of earthing switch namely in-built or separate free standing shall be as specified in schedule A. The tenderer 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.

5.2.2 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 tenderer shall state the type of offered earthing switch operation in schedule B. From rated voltages at and above 220kV, only double-action motion of the earthing switch blade shall be acceptable.

5.2.3 Special Requirements for Earthing Switches

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.

5.2.4 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.

Note: Service experience has shown that corrosion has a major influence on the performance of the equipment. 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 DSP 34-1658 for outdoor "high" to "very high" "C4" and "C5" (i.e. coastal) corrosively rating environments.
- b) The minimum detailed specification ("DS") for all exposed metal in accordance with DSP 34-1658 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 shall be not accepted.

The corrosion protection system (i.e. the equivalent detailed specification "DS" number in accordance with DSP 34-1658) offered by the manufacturer for the following components shall be stated in schedule B.

Corrosion protection details shall be provided with the tender documentation (refer to point d) hereunder:

- enclosures;
- nuts, bolts, studs and washers;
- bearing assemblies and linkages;
- structural steel (i.e. common base frame, support structure legs (if applicable), etc.); and
- other exposed metal (excluding main terminals).

- c) The supplier is required to identify the lubricants used and to submit details with the tender documentation (refer to 5.9.5 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).

- d) Material and Corrosion Protection Information

The supplier shall provide with the tender documentation the information on each supplied equipment type specified below:

Table 4: Material and Corrosion Protection Information

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

- Steelwork Requirements for Support Structures (if part of the supply)
 - i. Steel shall be in accordance with SANS 1431
 - ii. Steel shall be Grade 350W
 - iii. Steel shall be hot-dip galvanised in accordance with SANS 121
 - iv. Steel members shall be marked/stamped and clearly legible.
 - v. Welding shall conform to the requirements of SANS 10044.
 - vi. Welds shall be seal welded.
 - vii. Steelwork shall be fabricated, erected and levelled to a tolerance of $\pm 1.5\text{mm}$.
 - viii. Bolts and nuts shall be in accordance with SANS 1700:5.
 - ix. Bolts and nuts shall be Grade 8.8.

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- x. Bolts, nuts and washers shall be hot-dip galvanised in accordance with SANS 121.
 - xi. Holes shall have diameter of 18mm for M16 bolts.
 - xii. All works shall comply with the requirements of SANS 1200

5.3 Operating Mechanisms

5.3.1 Manually Operated Mechanism

- a) Eskom shall specify the required type of mechanism operation in schedule A. The tenderer shall state the type of offered mechanism in schedule B. The operating force of 750 N as per clause A.6.105.1.2 of SANS 62271-102 shall apply.
- 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 tenderer shall provide all these requirements at the tendering stage.
- c) Mechanism considered "acceptable" shall have the following design features:-

A robust steel handle of not less than 40 mm or greater than 55 mm outside diameter;

- The operation of swing type handles takes place in the horizontal plane.
- The operation of crank type handles takes place in a vertical plane.
- The height for the operating handle is between 1000 mm and 1200 mm above ground level.
- The length of a swing type handle is between 750 mm and 1200 mm.
- 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.
- There is adequate physical clearance to prevent injury to operating personnel.
- There are padlocking facilities provided in both the "open" and "closed" positions.
- There are padlocking facilities suitable for an Eskom standard padlock with an 8 mm shank.
- The open and closed positions are positively identified at the mechanism with labels "ON" and "OFF" respectively.
- A reduction gear box type mechanism shall require a maximum revolution of fifty (50) turns for a full operating cycle.
- The direction in which to achieve open and close is clearly indicated.
- 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 sub-clause 3f).
- The operating mechanism enclosure, handles and fixings shall be manufactured from 3CR12 stainless steel with corrosion protection in accordance with section 5.2.3, unless otherwise approved by Eskom.

5.3.2 Motor Operated Mechanism

- a) Eskom shall specify the required type of mechanism operation in schedule A. The tenderer shall state the type of offered mechanism in schedule B. Clause A.6.105.1.1 of SANS 62271-102 shall apply.

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.

- b) A readily available dc. supply voltage "conversion kit" may be required by Eskom from the Supplier in order to convert the disconnector operating mechanism from 110 V to 220 V dc or vice versa.

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- c) Motors shall be designed, rated and tested to the relevant IEC requirements and for the operating voltage specified in Schedule A.

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. The tenderer shall provide all details with tender documentation.

- d) Motor operated mechanisms shall be evaluated and approved by Eskom. The process shall be assisted by means of samples, drawings and factory visits. The tenderer shall provide all these requirements at the tendering stage.
- e) Mechanism considered “acceptable” shall have the following design features:-
- The output torque and operational characteristics are optimally matched to the driven equipment.
 - The speed of operation and end of motion drive characteristics takes place with no “bounce-back” action.
 - 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.
 - 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.
 - 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.
 - The main access to the mechanism interior is provided with a padlocking facility to accept an Eskom standard padlock with an 8 mm shank
 - For electrical and mechanical interlocks refer to clause 3.27.
 - 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.
 - It shall be practicable to measure the motor operational current by means of a “clip-on” type ammeter.
 - 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.
 - 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.
 - 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.
 - The open and closed positions are positively identified with labels “ON” and “OFF” respectively.
 - Open type motors and gears shall not represent a hazard when local operation is in progress.
 - 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 sub-clause 3f).

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- The operating mechanism enclosure, handles and fixings shall be manufactured from 3CR12 stainless steel with corrosion protection in accordance with clause 5.2.3, unless otherwise approved by Eskom.
 - No moisture ingress into auxiliary switches.
 - Moisture heaters.
 - IP 55 classification.
 - 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.

5.4 Enclosures

5.4.1 General Design

Enclosures shall be designed for facilitating access to the innards as well as preventing unauthorised access to controls in the case of motor operating mechanisms.

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.

5.4.2 Degrees of Protection

All enclosures shall comply with IEC Publication 60529 classification IP55.

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 and complies with IEC Publication 60529 classification IP55.

5.4.3 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 considers acceptable are the following features on the design offered:-
 - No seals are exposed directly to the environmental elements.
 - Seals on doors and removable panels are of extruded EPDM rubber or heavy duty foamed polyurethane.
 - Natural rubber or felt seals are not acceptable.
- c) Anti-condensation Heaters
 - To prevent internal condensation, motor drive mechanisms shall be provided with suitably rated permanently connected electric heaters.
 - The heater power shall be matched to the internal volume of the enclosure and shall not cause damage to internal components.
 - 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.
 - The heaters shall be mounted separately from the secondary terminal strip.

- The heater elements shall be shrouded and leads to the heater elements insulated by means of silicon rubber or ceramic beads not PVC.
- The electrical supply for heaters is 230 Volts ac.
- It shall be possible to isolate the heater by means of an approved isolating device.
- The heater control circuits shall comply with the requirements of Eskom 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.

5.5 Working Clearances and Personnel Safety

- The disconnector and earthing switch shall be installed in a manner that ensures safety to authorised personnel.
- Live parts shall be isolated by means of elevation.

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

- The electrical working clearance from ground to live parts at system voltage as required by statutory requirements contained in the Occupational Health and Safety Act No. 85 of 1993 shall be complied with. Working clearances are given in Table 5.

Table 5: Minimum electrical working clearances

<i>System voltage [kV]</i>	<i>Working clearance [mm]</i>	
	<i>Vertical</i>	<i>Horizontal</i>
22	2 800	1 400
33	2 900	1 500
66	3 200	1 800
132	3 700	2 300
220	4 300	2 900
275	4 800	2 400
400	5 700	4 000
765	10 200	8 900

- 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.
- Moving parts shall not pose any hazard to personnel or adjacent equipment. There shall be no shock hazards present to operating persons.
- 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.

5.6 Nameplates

- Every disconnector 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.
- The nameplates and their fixings shall be weather and corrosion proof and shall be stated in schedule B.

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- 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) Ratings of the equipment using the symbols according to sub-clause 5.10 of and SANS 62271-102 shall be indicated on the nameplate and in addition to the manufacturer's name and equipment type designation shall display at least the following information:
- Rated voltage, rated normal current and short time current values, duration *
 - Rated switching impulse withstand (U_s) for voltages above 132 kV
 - Rated lightning impulse withstand voltage (U_p)
 - Rated power-frequency withstand voltage (U_d)
 - Mechanical endurance class
 - Serial number
 - Year of manufacture
 - Standard to which equipment complies e.g. SANS 62271-102
 - Eskom order Number and contract number.
 - Eskom stock (SAP) number.
 - Rated supply voltage of auxiliary circuits
 - Main contact resistance (terminal to terminal)

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

In instances where motor and manual operated drives are supplied, a separate rating plate shall be provided giving details of the drive itself. This rating plate shall be a separate rating plate to the above and mounted outside the drive itself. In addition to the manufacturer's name and type designation it shall display the following information:-

- Rated control voltage (U_a) and current;
- Serial number
- Year of manufacture
- Mechanical endurance class
- AC supply voltage

5.7 Operating Labels

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

Where applicable, all labels shall be manufactured in accordance with 240-56062515 and shall be attached using inherently corrosion-resistant rivets or self-tapping screws. No stick-on labels, double sided tape or glue is accepted, unless otherwise approved by Eskom.

5.8 Mechanical Features

5.8.1 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 disconnecter will be assessed by Eskom and be modified at no cost if required.

5.8.2 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.

5.8.3 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.

5.8.4 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.

5.8.5 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.

5.8.6 Main Terminals

- a) The main 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 40 mm pitch 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.
- b) At 11 kV to 66 kV four (4 x 50 mm) holes pad shall be acceptable. At 132 kV only four (4 x 50 mm) and 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.

- c) 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.

5.8.7 Earthing Switch Terminal

For earthing switches an earthing switch terminal per pole shall be provided, suitable for a copper flat type conductor strap (50mm x 3mm) 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 earthing switches, the following main terminals shall be provided:

- a) 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 66kV and above. The diameter of the holes shall be 14 mm;
- b) Dimensional details of the main terminals shall be shown on the earth switch general arrangement drawing.

5.8.8 Current Paths

- a) Current paths shall be designed for a minimum maintenance interval of twelve (12) years.
- 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.
- d) Pantograph type disconnectors shall have current path designs which eliminate the need for major overhauling, other than at the main contact zone.
- 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 disconnector.

5.8.9 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) Disconnectors for use in systems of nominal voltage up to and including 132 kV shall be tested at Eskom's KIPTS pollution test site in accordance with 240-56062330. Refer to sub-clause q) below for information on Eskom's technical acceptance. Only for items in which it is requested, KIPTS certificates must be supplied for Medium (M), Heavy (H) and Very Heavy (VH) pollution cycles. The KIPTS test facility limitation is currently (as at 2014) up to 132kV. Therefore the test requirement is split according to nominal system voltage level as follows:
- $U_n \leq 132\text{kV}$: For insulators for applications up to nominal system voltages of 132kV (i.e. lightning Impulse withstand up to and including 550kV), the Eskom KIPTS "Natural aging and pollution performance test" is to be conducted in place of the IEC 60507 artificial pollution test. The test shall be according to Eskom procedures 240-56062328 and 240-56030420. The test commencement date and test duration shall be as defined in 240-56030420.
- 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 at the tendering stage.
- g) The standard colour for post insulators shall be dark brown, if porcelain.

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- h) There shall be exact interchangeability between post insulators irrespective of the supplied creepage distance.

5.9 Operation Interlocks between Disconnecter and Earthing Switch

5.9.1 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.

5.9.2 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).

5.9.3 Indicating Devices

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

5.9.3.1 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.

5.9.4 Electro-Magnetic Compatibility (EMC)

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

5.9.5 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 at the tendering stage to list the lubricants and or compounds used and to submit details 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).

5.10 Inspection and Maintenance

5.10.1 General

The effectiveness of maintenance depends mainly on the way instructions are prepared by the OEM and implemented by Eskom. The supplier shall supply maintenance information in the form of maintenance manuals, field service bulletins and Digital Video Disk (DVD) material covering the following aspects:

Extent and frequency of maintenance for this purpose, the following factors shall be considered:

- a) Switching operations (accumulated switching amperage);
- b) Total number of operations;

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- c) Environmental conditions; and
- d) Measurement and diagnostic tests for condition monitoring.

5.10.2 Inspection

With the tender documentation (refer to sub-clause 13.2.1m), the supplier shall submit the quality control plans to Eskom, indicating all inspection hold points. Eskom may add the necessary inspection hold and/or witness points for Eskom or its appointed representative. 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 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 8 weeks.

5.10.3 Scope of Work to be performed:

It shall include but not be limited to the following:

- a) Recommended place for the maintenance work (indoor, outdoor, in factory, on-site, etc.);
- b) Procedures for inspection and maintenance, diagnostic tests, examination overhaul;
- c) Reference to drawings;
- d) Reference to part numbers or standard kit of parts;
- e) Tools required, including special equipment or tools;
- f) Precautions to be observed (e.g. cleanliness);
- g) Lubrication procedures; and
- h) Cleaning materials.

5.10.4 Graphical Information:

- a) Detailed drawings and sketches of the disconnecter components, with clear identification (part number and description) of assemblies, sub-assemblies and essential components.
- b) Expanded detail drawings, which indicate the relative position of components in assemblies and sub-assemblies, are expected as a preferred illustration method. Graphs and similar means of portraying important information shall also be included.
- c) Specified operational values:
 - Values and tolerances pertaining to which, when exceeded, make corrective action necessary, for example:
 - Operating times and contact velocities;
 - Resistance of the main current carrying circuits;
 - Torque settings for fasteners; and
 - Important dimensions.
- d) Specifications for materials:
 - This includes warnings of known non-compatibility of materials.
 - Fluid; and
 - Cleaning and degreasing agents.
- e) Tools, lifting and access equipment:
 - A list of standard and specialised tools shall be provided with description of their application and associated part number.

f) Tests after the maintenance work:

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

5.10.5 Maintenance DVD

- a) It is anticipated that maintenance intervals for the disconnecter will be very long, e.g. several years. Consequently, it is essential that the instruction manual be supplemented and supported by a maintenance orientated video recording. The video recording shall be converted into a suitable DVD format. A written commitment from the supplier regarding the submission of the DVD shall be provided with the tender documentation. The actual DVD shall be supplied upon awarding of the contract following approval of the maintenance manual by Eskom. Copies of the DVD shall be issued to the contract manager and relevant technical specialists.
- b) The DVD shall provide a record of the maintenance requirements and procedures for the equipment supplied. The DVD and related instruction and maintenance manuals shall be detailed enough to enable a trained maintenance crew to perform all inspections and maintenance required on the equipment. It is anticipated that the instruction manuals will list what maintenance is required, while the DVD will show how such maintenance is achieved.
- c) The DVD shall cover routine 1st line (inspection), 2nd line maintenance and specialised (intrusive) overhauling of all equipment requiring such work, as well as some trouble-shooting techniques 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 DVD shall concentrate on equipment maintenance and 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.
- d) These sections may be on separate DVDs or if consolidated into a single DVD, there shall be adequate indexing to permit quick access to the desired section. For each piece of equipment requiring maintenance, the DVD 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 dismantling steps, including any marking of positions required prior to disassembly, any discharging of pressure and/or stored energy;
 - The dismantling, 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;
 - 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.
- e) The trouble-shooting portion of the DVD 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.

5.11 Condition monitoring of disconnectors

The supplier is encouraged to develop practical and innovative methods to improve the reliability and maintainability of the disconnecter installation. This may include on-line condition monitoring and/or integrated diagnostic devices achieving the following functions:

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- Accumulated interruption amperage values (per pole);
- Contact wear (per pole); and
- Continuous monitoring, recording and alarm signalling of the mechanical operating characteristics of the disconnecter.

The on-line condition monitoring and/or integrated diagnostic device shall be IEC61850 protocol compliant.

Required routine checks and maintenance actions of a minor and major nature required in order to ensure correct operation of the equipment.

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.

5.12 Dismantling and Replacement of Major Parts

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

5.13 List of Tools

- a) 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.
- b) 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.
- c) All operating tools shall be fitted on the inside of the mechanism enclosure.

5.14 Training

Refer to the training specification which is 240-56065202: Switchgear training requirements from original equipment manufacturers.

5.15 Drawings

5.15.1 Outline and General Arrangement

The minimum information shall include (also refer to sub-clause 13.2.1c):

- 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. 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 steel support structure in accordance with the drawings specified in Table 6 below:-

Table 6: Eskom standard drawings for outdoor disconnectors and earthing switches steel support structures which are in line with Eskom civil foundations

System voltage [kV]	Spacing [mm]	Steel support structure drawing number
22	1 000	0.54/505 ; D-DT 5205
33	1 200	0.54/493 ; D-DT 5204
44	1 800	0.54/490

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System voltage [kV]	Spacing [mm]	Steel support structure drawing number
66	2 000	0.54/2235 ; D-DT 5203
88	2 400	D-DT 17501 sheet 2 of 2,
	2850	0.54/7500 – In-line, no earthing switch
	2400	0.54/7483 – L/ H earthing switch
	2400	0.54/7485 – R/ H earthing switch
	2400	0.54/7484 – Double earthing switches
	2400	0.54/4196 – Transverse/ In-line
132	2400	D-DT 5202 sheet 2k
	3000	0.54/7486 – No earthing switch; D-DT 5202 sheet 2A
	3000	0.54/7487 – Double earthing switches, Motor
	3000	0.54/7488 – Double earthing switches
220 and 275	4300	0.54/7489 – isolator (2440 mm high)
		0.54/7490 – isolator (2330 mm high)
		0.54/7491 – isolator (2450 mm high)
		0.54/7492 – pantograph 3600 mm high
		0.54/7493 – pantograph (9500mm high)
400	5500	0.54/3983 – isolator
	6500	0.54/3293 – isolator
	7010	0.54/4432 – isolator
		0.54/3558 – earth switch
		0.54/7494 – pantograph (3300mm high)
		0.54/7495 – pantograph (3450mm high)
765	11 000	To be as per schedule A
	14 000	To be as per schedule A

5.15.2 Phase spacing:

- For 132kV: all disconnectors and earthing switches should be offered with phase centres of 2400mm, 3000mm and 3600mm.
- For 220kV and 275kV: all disconnectors and earthing switches should be offered with phase centres of 4300mm and 6700mm. The 4300mm 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.
- For 400kV: all disconnectors, pantographs and earthing switches should be offered with phase centres of 5500mm, 6500mm and 7010mm. The 5500mm dimension is standard for tubular bus bar designs.
- For 765kV: all disconnectors, pantographs and earthing switches should be offered with phase centres of 11 000mm and 14 000mm.
- Details of main terminals and earthing switch terminals;
- Maximum permissible loading on main terminals (with directions) expressed in Newtons;
- Mass of equipment in kilograms, which shall include the mass and description of the heaviest component. If necessary operating forces produced between the poles.
- Any special trenches or support steelwork required between phases;

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-
- i) Where applicable, a dimensioned outline and general arrangement drawing including foundation details of the supporting structures offered, if not included in the above.
 - j) Forces - operating forces and directions for all operations (dynamic and static.)
 - k) The centre of gravity
 - l) Title to include nominal voltage, normal current rating and short-circuit withstand current and duration in the title blocks of the drawings.
 - m) 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].

5.15.3 Drawings

Drawings showing the generic layout of all the nameplates or rating plates (disconnectors and operating mechanisms, as per clause 13.2 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 contract number – for population after awarding of the contract;

5.15.4 Schematic wiring diagram with the 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 contract number – for population after awarding of the contract;

- a) Contacts shall be shown with the main contacts in the open position, contactors in the de-energised condition, refer to clause 12.6 of this standard.
- b) The status of these items shall be clearly described in the diagram. Diagrams shall show the relative timing of main and auxiliary contacts and tolerances in timing between the auxiliary contacts in accordance with the Eskom drawing D-DT 5045.
- c) Drawings shall be labelled in English.

5.16 Inspection and Tests

5.16.1 General

Manufacture, factory inspection, shipping, off-loading, storage on site, erection and site tests shall be as per document QM-58.

5.16.2 Test Reports

Single copies of type-test reports and a typical routine test report shall be submitted to Eskom at the tendering stage for approval.

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

5.16.3 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 prior to acceptance.

5.16.4 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

5.16.5 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).

5.16.6 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.

5.16.7 Indication and Signalling of Position

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 5.16.5 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:

The isolating distance or gap is visible;

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

b) 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.

c) 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 sub-clause 5.16.7.

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.

5.16.8 Maximum Force Required for Manual Operation

The values given below also apply to maintenance and operation of normally motor-operated disconnectors and earthing switches.

NOTE these values include ice-breaking, if applicable.

The operating height above servicing level should be agreed between manufacturer and user.

5.16.9 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) shall not be higher than 60 N with a possible peak of 120 N during a maximum of 10 % of the total required revolutions.

5.16.10 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) should not exceed 250 N (refer to sub-clause 5.6.3 of SANS 62271-1). A peak value of 450 N is accepted during a rotation of 15° maximum.

5.16.11 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.

6. Tests

6.1 Type Testing

- a) Equipment shall be type tested in accordance with the requirements of SANS 62271-102. The following type tests shall be carried out:
- b) Dielectric tests (refer to clause 6.2 of SANS 62271-102);
 - 1) Power frequency withstand voltage tests
 - 2) Lightning impulse dry withstand voltage tests
 - 3) Switching impulse voltage tests of switches rated 300 kV and above
- c) Radio interference (RIV) test (refer to clause 6.3 of SANS 62271-102);
- d) Measurement of the resistance of circuits (refer to clause 6.4 of SANS 62271-102);
- e) Temperature rise tests (refer to clause 6.5 of SANS 62271-102);
- f) Verification of the protection (refer to clause 6.6 of SANS 62271-102);
- g) Electromagnetic compatibility tests (EMC) (refer to clause 6.9 of SANS 62271-102);
- h) Test to prove the short-circuit making performance of earthing switches (refer to clause 6.101 of SANS 62271-102);
- i) Operating and mechanical endurance tests (refer to clause 6.102 of SANS 62271-102);
- j) Operating under severe ice conditions (refer to clause 6.103 of SANS 62271-102). The class of ice coating shall be class 10 in accordance with SANS 62271-102;
- k) Operation at temperature limits (refer to clause 6.104 of SANS 62271-102);
- l) Test to verify the proper functioning of the position indicating device (refer to clause 6.105 of SANS 62271-102);
- m) Bus-transfer current switching tests (refer to clause 6.106 of SANS 62271-102);

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- n) Induced current switching tests (refer to clause 6.107 of SANS 62271-102);
- o) Bus-charging switching tests (refer to clause 6.108 of SANS 62271-102);
- p) The manufacturer shall perform a complete set of type tests for each disconnector design offered. The type test certificates and reports shall be submitted for review during the tender or product evaluation stage. Type test reports shall be specified according to SANS IEC 62271-102. All type tests done on IEC 60129 shall not be accepted. All the testing shall be carried out with the disconnector wholly assembled.
- q) The disconnector of voltages 132kV and below shall have been type tested in accordance with the KIPTS natural ageing and pollution performance test procedure for outdoor insulator products, Section 0 and Section 4 – Particular requirements for other insulator products (34-224 & 34-216). The products which have KIPTS certification will be technically preferred suppliers if all other tender returnables are successful, see Technical Bulletin 06TB-027.
- r) 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 tenders. Any limitations shall be clearly stated. The manufacturer and or supplier shall be responsible for all the costs related to testing.
- s) The manufacturer shall perform a complete set of type tests for each design as well as routine tests on each unit. The type test certificates and reports shall be submitted for review during the tender or product evaluation stage.

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

6.2 Witnessing of Tests

- a) Eskom reserves the right to be present at any of the tests specified. The supplier shall specify 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 not less than fourteen days' notice of the firm date when the witnessing of the tests shall be ready. For overseas suppliers the minimum required notice is 8 weeks.

NOTE where applicable, the minimum required notification period for overseas travel from South Africa is 8 weeks.

- b) Eskom shall be notified as soon as possible but within 48 hours of all the test failures and corrective actions. This shall take the form of a brief report that shall, upon request, be supported by a more detailed report. It is desirable that Eskom is notified of test failures to allow in situ inspection if desired.

6.3 Test Certificates and Test Reports

- a) Type test certificates together with each complete test report shall be supplied only in the English language in electronic format with the tender documents.
- b) Copies of the routine test certificate and reports shall be supplied with the tender documentation in electronic format. The test certificates shall indicate the tests performed and results, type designation of the equipment tested, etc. and shall make provision for approval by an Eskom authorised representative.
- c) One hard copy of the routine test certificate and or report shall be supplied with the disconnector and stored in the documentation pocket inside the mechanism enclosure. In addition to the hard copy, the routine test certificates and or report shall be made available in electronic format and submitted to Eskom.
- d) All test records shall be supplied for each disconnector offered and the record must be in an MS Windows based software e.g. MS Excel and in English language.

6.4 Grouping of Tests

Sub clause 6.1.1 of and SANS 62271-1 is applicable with the following mandatory type tests where applicable:

a) **Mandatory Type Tests:**

Tests to prove satisfactory operation and mechanical endurance (clause 6.102) (M);

b) **Optional Type Tests:**

- Tests to prove the short-circuit making performance of earthing switches (clause 6.101);
- Tests to prove satisfactory operation under severe ice conditions (clause 6.103);
- Tests to prove satisfactory operation at temperature limits (clause 6.104)
- Test to verify the proper function of position indicating device (clause 6.105 annex A;
- Tests to prove the bus-transfer current switching capability of disconnectors (clause 6.106 and annex B);
- Tests to prove the induced current switching capability of earthing switches (clause 6.107 and annex C);
- Tests to prove the bus-charging current switching ability of disconnectors used in metal enclosed switchgear (clause 6.108 and annex F);

6.5 Information to be included in the Type Test Reports

a) The following details concerning insulators used during the type tests are of particular importance and shall be given in the relevant test reports:

- Rated cantilever strength;
- Rated torsion strength of support insulators (and operating insulators, where applicable);
- Height and number of elements
- Creepage distance and shed-profile.
- Forces on the insulators during all stages of operation and direction of forces.

b) In the case of dielectric tests, information shall be included regarding the smallest gap at which the indicating or signalling device can signal the position OPEN. The minimum size of the gap and the height above ground used for the test shall be stated. Also the distance of the lowest part of insulation to ground shall be given.

7. Manufacturing, Transport, Storage, Installation, Pre-commissioning and After Sales Technical Support

7.1 Manufacturing

- a) The manufacturing, transport, storage, installation and pre-commissioning of disconnectors, as well as their operation and maintenance in service, shall be carried out in accordance with the instructions given by the OEM.
- b) 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.
- c) Eskom 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.

7.2 Inspection of manufacturing facilities and disconnectors

- a) Eskom reserves the right to inspect and evaluate all manufacturing facilities relating to the disconnector offered.
- b) Eskom reserves the right to inspect any ordered disconnector before shipment, or at any stage of manufacture. This inspection will entail a thorough check to ensure complete compliance with this standard, switchgear schedules and the approved manufacturer's drawings.
- c) With the tender documentation, the supplier shall submit the quality control plans to Eskom, indicating all inspection hold points. Eskom may add the necessary inspection hold and/or witness points for Eskom or its appointed representative. 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 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 8 weeks.

- d) Any deviations in the disconnector 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.
- 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.

7.3 Conditions during Transportation, Storage and Installation

- a) Conditions can be expected to be onerous during transport, storage and installation. Adequate precautionary measures shall be provided for the protection of sensitive components such as insulating parts and operating mechanisms during transport, storage and installation.
- b) Vibrations and impacts during transport shall also be applied. Refer to clause 10f) for the requirements for non-resettable impact recorders.
- c) The equipment shall be designed, manufactured and packaged appropriately to contend with the conditions arising during shipping and handling (including corrosion of exposed parts). The supplier shall demonstrate this either by testing or through previous satisfactory experience.
- d) 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;
- e) Vibration test: this test may be used to supplement actual shipping tests to check for unexpected shortcomings in the equipment and packaging; and
- f) Weather-proof test: this test may demonstrate the adequacy of the packaging to prevent ingress of moisture and water from weather or sea conditions.
- g) If the design of the equipment is mature, and the equipment has previously been shipped successfully from OEM premises to the offloading point under similar conditions, the above tests may be waived at Eskom's discretion.

7.4 Transportation, Off-loading and Storage

- a) The supplier shall be responsible for the transportation and off-loading from OEM premises to offloading of the equipment on site. Off-loading includes transportation from the point of off-loading the equipment after transportation to the point of installation.
- b) The supplier shall provide his own means of off-loading at the point of installation. Non resettable impact gauges should be applied and set to a level below the level where the impact will cause damage.

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7.5 Storage

- a) If any equipment requires maintenance or attention during storage, this shall be clearly stated in the contract and Eskom's attention shall be drawn to this fact. This information shall be submitted with the tender documentation as well as with orders upon awarding of a contract. Crates supplied for transport shall be suitable for site storage for a period up to 6 months in the case where installation outages are delayed.
- b) At the time of off-loading at an Eskom facility, the supplier has the responsibility to ensure that the necessary steps are taken by Eskom to ensure satisfactory storage.
- c) Where heaters need to be energised, a clearly marked and accessible electrical connection point (refer to 10f) point 16) shall be provided to enable Eskom to supply power to the heaters.
- d) Storage for a period of up to 6 months in the case when installation outages are delayed.
- e) The supplier shall implement proper storage and handling (de-stuffing) procedures. A copy of the storage and handling procedures shall be made available to Eskom for acceptance. This shall indicate the maximum recommended period of storage, as well as recommended actions to be taken if a longer storage period is required.

7.6 Installation

- a) The supplier shall be responsible for the installation and pre-commissioning of the equipment when required by Eskom. This includes the supply of all installation tools, lifting tackle and test equipment.
- b) The supplier shall be responsible for ensuring the training and accreditation of persons employed for the installation and pre-commissioning of switchgear.

NOTE: Eskom will normally provide the support structures (unless otherwise specified) under a separate contract/order.

- c) Installation includes mounting and securing the equipment and its support structure onto the concrete support foundation, levelling of the disconnector, where applicable.
- d) For each type of supplied disconnector, the installation instructions provided by the supplier according to the OEM's instructions shall at least include the items listed below:
 - Unpacking, inspection 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 disconnector 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 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; and
 - ii. The mass of the heaviest part of the apparatus to be lifted separately if it exceeds 100 kg
 - iii. The length of thread protrusion on each bolt shall be minimum of 3 threads past the nut;
 - iv. Qualification of personnel: all personnel employed by the supplier who is involved in the installation and pre-commissioning of the disconnector 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 for approval prior to installation and pre-commissioning of equipment by the individuals concerned; and

-
- e) Final installation inspection and testing: instructions shall be provided for inspection and testing after the switchgear and control gear has been installed and all the interfacing connections have been completed.
- These instructions shall include the following:
- Procedures for carrying out any adjustment that may be necessary to achieve correct operation;
 - Recommendations for any relevant measurements that should be made and recorded to help with future maintenance decisions; and
 - Instructions for final inspection and testing.
- f) 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.
- g) Installation tools / equipment and debris shall be removed from site when installation is completed.
- h) Power supplies for installation purposes can be made available on the construction site.

7.7 On-site work requirement

7.7.1 Supplier responsibilities

The supplier shall be responsible for ensuring the training and certifying of persons employed for the installation and pre-commissioning of switchgear.

NOTE: The first unit to be erected under the contract shall be witnessed and written approval given by Eskom in order to ensure that the both the equipment and work carried out 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.

7.7.2 Requirements

Erection of the equipment shall include:-

- a) Off-loading and supply of all equipment required for installation and inspection.
- b) On completion of the erection works removal from site of all surplus equipment.
- c) Site testing (pre-commissioning tests) of the installed equipment as specified in sub-clause 13.2.2 of this standard.

7.7.3 Competency of Erection Staff

- a) All persons appointed to supervise or act on the Contractor's behalf with respect to site erection work shall be fully competent in the erection as well as assembly of the equipment - and be approved in writing by Eskom.
- b) The Contractor shall possess and maintain a competency file containing pertinent details of all persons used to supervise and perform site erection work.

Training and accreditation of all staff entrusted with on-site erection plus obtaining approval in writing by Eskom shall be the responsibility of the Contractor

7.7.4 Pre-commissioning

- a) Each disconnector shall be tested after installation in accordance with clause 9 to assure proper installation and that no damage occurred during transportation. The pre-commissioning tests shall be witnessed by an appointed Eskom representative/official. To facilitate the testing, adequate D.C. power supplies, test equipment and suitably qualified and accredited personnel shall be provided by the supplier.
- b) A disconnector pre-commissioning test report shall be submitted to Eskom, comprising the following parts:
- After the measurements at the substation site, a hand-written pre-commissioning test report shall be handed over to the appointed Eskom representative/official;
 - Within three weeks after the pre-commissioning tests, the supplier shall submit an official report to Eskom (two hardcopies); and
 - An electronic copy of the official report shall be provided on a CD for each individual disconnector. All the measured values shall be clearly stated in the report as well as the following:
 - Test/measuring equipment information/data:
 - i. Make and type of instruments;
 - ii. Serial numbers of instruments;
 - iii. Methods of triggering operating pulse;
 - iv. Measuring methods;
 - v. Calibration certificates of the measuring instruments used, from an accredited laboratory, e.g. SANAS;
 - vi. The disconnector data:
 - vii. Make and type;
 - viii. Serial numbers of poles and mechanisms;
 - ix. Rated voltage, normal current and short-circuit breaking current;
 - x. The name of the substation and section;
 - xi. Disconnector identification and application;
 - xii. Date of commissioning; and
 - xiii. Date and time of testing/measuring
 - Clear copies of the complete printouts of the mechanical characteristics and 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 deems it necessary, the deviation shall be corrected by the supplier. If the disconnector is found to be faulty during the tests, a fault report shall be completed in addition to the pre-commissioning test report.
 - After the final inspection, the final commissioning of the plant is performed and the hand-over documents shall be provided to Eskom by the supplier.

7.7.5 On-site pre-commissioning testing

The following tests/inspections shall be done on completion of erection and prior to handing over of the equipment:

- a) Motor current measurement (if applicable)
- b) Current path resistance measurement (i.e. terminal to terminal and each joint).
- c) Contact travel, end position and alignment (including bus transfer devices, where applicable).
- d) Complete operational check, including auxiliary switch function. (5 open and 5 close operations).
- e) Disconnector closing and opening time (motor driven types only).
- f) Operating force measurement for manual type drives
- g) Operating forces measurements of motor drives (in electrical and mechanical units).

The above shall be recorded on a test record sheet and signed off by the Contractor's representative.

The results of pre-commissioning tests after installation on site shall be documented, signed off and a copy of the results included with the switchgear documentation for hand-over as part of the quality process. All tests shall be witnessed by Eskom.

7.7.6 After Sales Technical Support

The supplier shall provide locally based technical support on a full time bases for the duration of the contract.

8. Safety, Health and Environment and Quality

These shall be in accordance with Eskom SHEQ requirements.

9. Final Installation and Inspection

- 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's 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.

10. Packaging and preservation requirements

- a) Each disconnector shall be "unit-packed". In other words, the components making up a complete disconnector shall be delivered to site in one or more packing containers which shall contain only the component for one complete individual disconnector.

NOTE: Bolts and nuts shall not be stored in plastic bags, but in laminated wooden crates or boxes.

- b) All disconnector 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) outdoors. Refer to QM-58 on how to handle preservation.
- c) Packaging shall prevent damage to the disconnector 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 disconnector, each crate shall be clearly and sequentially marked in order to identify each crate as belonging to a specific disconnector (e.g. "CRATE 1 of 3", "CRATE 2 of 3", etc.).
- f) 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 order number;
 - Eskom SAP number;
 - Disconnector description (including the rated voltage, normal current, rated short-time withstand current, auxiliary D.C. control voltage; specific creepage; "1P" or "3P");
 - Manufacturer's name (i.e. make of disconnector)
 - Manufacturer's disconnector product designation/code (i.e. type of disconnector);
 - 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;
 - Exposed shafts, bearings and machined surfaces shall be treated with a temporary anti-corrosive coating.
 - Loose components or components that are subject to damage from exposure to dust or water shall be packed in hermetically sealed plastic bags;
 - All components shall be clearly marked. Components that are physically impossible to mark shall be individually packed and the packaging shall be marked.
 - 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).
 - A readily accessible (i.e. without the need to remove / disturb the external packaging) external temporary supply 230 V ac connection point for the heater circuit during storage shall be provided and wired to the Eskom 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 ac 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 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.
 - A non-resettable impact recorder or detector shall be provided and located in such a position so as to record/detect the acceleration of the disconnector body and not the packaging, the setting shall be the lowest impact which can be endured before damage is caused.

- A copy of the installation instructions with lifting instruction and photos or pictures are included and the Bill of Materials (BOM) shall be provided with the delivery note for each accessory supplied in order to allow the recipient to confirm that all items on the BOM have been delivered, and for record purposes.

11. Spares

11.1 General

- a) Spare parts to be identified by means of a unique part number to facilitate ordering.
- b) Spares will normally be purchased at the same time that orders are placed for disconnectors. The supplier shall provide a list of the minimum recommended spares in the current path and the mechanism.

NOTE: Delivery to any of the specified destinations should remain valid for the duration of the contract period.

11.2 Availability of Spares

- a) 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 control gear.
- b) Spares required under emergency breakdown conditions shall be readily available with a maximum lead time of 48 hours from date of purchase order. The supplier shall state the lead time offered in schedule B. This excludes spares required for scheduled maintenance.
- c) 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.
- d) 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.
- e) The supplier shall undertake to supply to Eskom all the necessary replacement parts for the disconnector throughout its expected service life. If the manufacture of the specific make and type of disconnector (or any of its replacement parts) is discontinued, Eskom shall be advised in writing.
- f) 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:
 - 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.
- g) This information shall be supplied to Eskom in a legible and acceptable format in English when notice of discontinuation of the disconnector or any of its replacement parts is given. In this case, Eskom will be able to make alternative arrangements to obtain the necessary replacement parts. Another option is to pool spare parts: the supplier shall state spares availability philosophy with the tender documentation.

11.3 Identification of Spares

- a) Spares shall be identified by a unique number and cross-referenced in the instruction manual. Large spares such as poles and operating shafts 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 packaging containing spares.

11.4 Packaging, preservation and storage of spares

Refer to QM-58 on how to handle preservation. Care shall be taken to ensure that spares are protectively packed for satisfactory long-term storage. Maintenance spares will usually be stored indoors.

12. 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 to be fitted between the mechanism box and the gland plate.

12.1 A Dimension of the Gland Plate shall be:-

- a) Minimum available area of the gland plate shall be at least 75 mm x 75 mm for manual operated disconnectors of 66kV 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 cabling (e.g. inter-pole cabling) shall be manufactured using galvanized steel, unless otherwise approved by Eskom.

NOTES:

- 1) The use of aluminium cable racking is considered to present a theft risk and will not be accepted.
- 2) Where Eskom 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 in accordance with 240-56030489, unless otherwise approved by Eskom.

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's control cables will be terminated shall comply with Distribution Specification 34-253, for rated voltage below 220 kV. For 220 kV and above voltage, Eskom shall specify.
- e) The terminal blocks shall be of the screw clamp, spring loaded insertion type.

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- f) The terminal width of 10mm 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 approved type of terminal shall be supplied. The sample of it shall be submitted at tendering stage for Eskom approval.
- m) At least 4 spare terminals shall be provided.

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 interface standard drawings, 0.54/07129; 0.54/07858; 0.54/07860 and 0.54/07858, or otherwise on a drawing stated in schedule A.

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

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.

12.5 Auxiliary Switches

- a) Auxiliary switches shall be of an approved type. Approval shall be determined at the tendering stage by means of a sample provided for evaluation by Eskom.
- b) Auxiliary switches shall be rated according to the values specified in schedule A. The tenderer 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 tenderer 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.

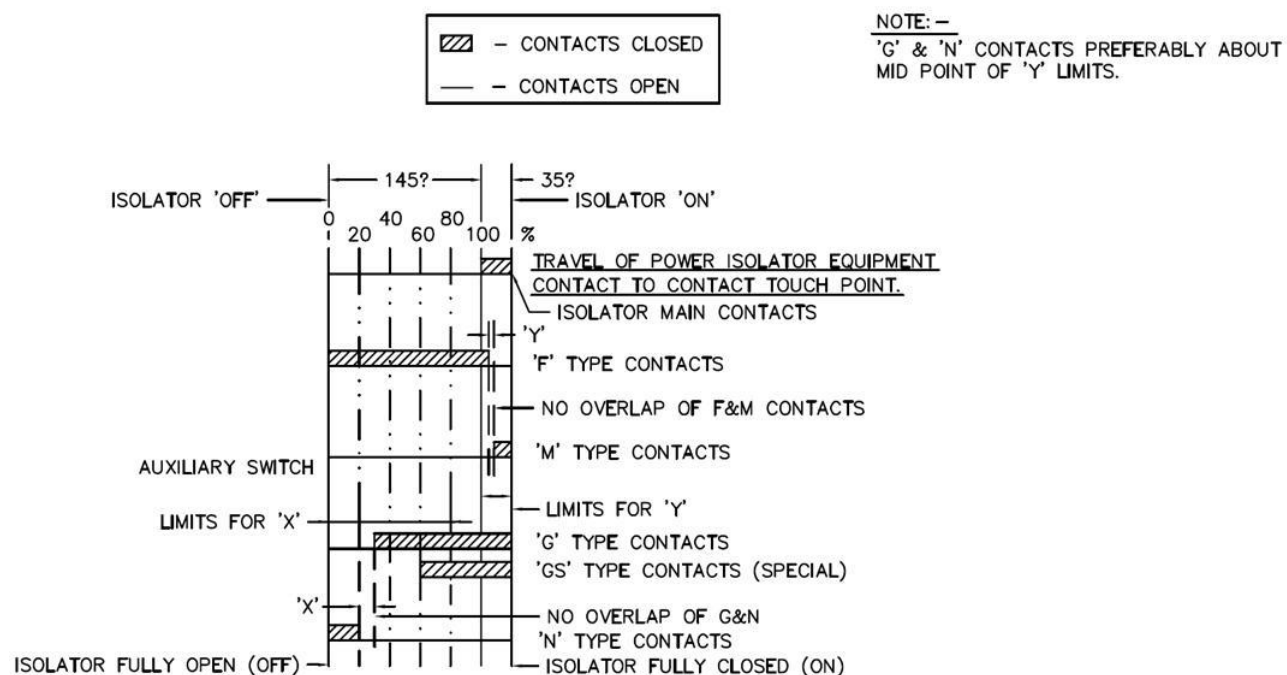


Figure 1: Auxiliary switch contacts timing diagram

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 for design purposes and final approval shall reflect this convention which is in accordance with Eskom drawing D-DT 5045.

13. Documentation

13.1 Responsibilities

The responsibilities of both Eskom and the supplier for the disconnectors, earthing switches and associated equipment shall be enumerated as below.

13.2 Supplier's Responsibilities

13.2.1 Supplier's Responsibility at Tendering Stage:

The Supplier shall be responsible for the following:

- a) At the tendering stage provide a complete set of technical documentation and completed technical schedule B for each disconnector 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) In the case of evaluation at the factory of disconnector 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 evaluation by Eskom before erecting on site. Unless otherwise agreed by Eskom;
- c) A full set of general arrangement (GA) drawings (also refer to clause 5.15) showing the following minimum information:
 - 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 contract number – for population after awarding of the contract;
 - 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 above ground, mechanism enclosure dimensions, overall height, width and depth of disconnector, etc.;
 - 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];
 - properly annotated drawing with a complete list of major components (bill of materials);
 - 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);
 - details of the main earthing terminal and mechanism enclosure earthing terminal;
 - 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;

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- any special trenches or steelwork required between phases;
 - for disconnectors used in systems with nominal voltages above 400 kV, the support structure dimensioned outline and general arrangement and holding down bolts details;
 - for disconnectors used in systems with nominal voltages above 400 kV, the support structure earthing terminal;
 - for disconnectors used in systems with nominal voltages above 400 kV, the support structure label mounting holes;
 - 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;
 - maximum torque required for the foundation holding down bolt nuts used to secure the support structure base plate (Nm);
 - dynamic horizontal force (N) exerted during operation on the foundation – vector showing location, magnitude and direction;
 - dynamic vertical force (N) exerted during operation on the foundation – vector showing location, magnitude and direction;
 - dynamic moment (Nm) exerted during operation about the foundation – showing location, magnitude and direction;
 - relative location of disconnector poles, base-frame and operating mechanism enclosure(s);
 - location of all enclosure doors and handles;
 - location and annotation of control facilities;
 - location and layout of LV control cable gland plates; and
 - location of nameplate on disconnector;
 - details about the bus transfer device;
 - layout of terminal strips;
- d) for all external insulation (i.e. post-insulators), detailed 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 contract number – for population after awarding of the contract;
- a general arrangement drawing of the operating mechanism enclosure. 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 contract number – for population after awarding of the contract;
- e) full list of spares required for maintenance (refer to clause 11);
- f) full list of operating tools
- g) detailed list of standard tools required for 2nd line maintenance
- h) full list as well as copies of type test certificates and reports as specified in the specification;
- i) generic routine test certificates for the disconnectors;
- j) transport, storage, installation, operating and maintenance manuals (refer to clause 7);
- k) training material and courses (refer to clause 5.14);
- l) impact recorders and

- m) the submission, where applicable, of the following additional information:
- quality control plans indicating all inspection hold points (refer to sub-clause 5.10.2);
 - details of equipment requiring maintenance during storage (refer to sub-clause 13.2.2 a));
 - copy of the storage and handling procedures which indicate the maximum recommended period of storage (refer to sub-clause 13.2.1 d));
 - a written commitment from the supplier regarding the submission of the maintenance DVD (refer to sub-clause 5.10.5); and
 - spares availability philosophy (refer to clause 11);
 - Information about bushes and method of lubrication (refer to sub-clause 5.8.3).
 - Information about rating plate fixing (refer to sub-clause 13.2.1a)).
 - The list of greases as per clause sub-clause 5.9.5.

All the documentation required in this standard and Schedule A to be submitted at tendering stage. 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 document 240-56065202: Switchgear training from original equipment manufacturers.

13.2.2 Supplier's Responsibility upon Awarding Contract:

- a) 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).
- b) Where heaters need to be energised, an electrical connection point (refer to sub-clause 7.5c)) shall be provided to enable Eskom to supply power to the heaters.
- c) Within one month of contract award supply documentation as per this clause 13.
- d) Provision of OEM accredited off-loading, erection and pre-commissioning activities.
- e) All documentation relevant to the disconnecter, including routine factory test certification shall be available with the equipment on-site, prior to any erection taking place.
- f) Unless otherwise ordered, provision of fully compatible type hot-dip galvanised steel support structures and drawings for disconnectors and earthing switches.
- g) Checking and verifying that supporting structures are erected and aligned to the requisite standard before commencing with erection.
- h) Provision of all necessary auxiliary equipment such as manual operating handles for motor drives.
- i) Supply of conductor terminal pad and all necessary bolts and fasteners for erection and any further items required to complete the installation.
- j) Complete assembly and erection of the main equipment (if erection is called for) ready for service. This shall include items such as the upper contact assembly for pantograph type disconnectors – see paragraph below.
- k) For disconnectors of the pantograph type, provision of all associated equipment such as upper contact assemblies (including bus transfer switching devices), upper conductor clamping arrangements and main terminal adapters (if required).
- l) Re-alignment and re-adjustment of equipment after connection of the main conductors.
- m) Supply of complete disconnector or earthing switch ready for handing over.

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- n) Pre-commissioning testing and recordings as per sub-clause 7.7.4 of this standard using accredited resources and approved methodology.
 - o) If during the normal life of the supplied equipment, Eskom requires notification about necessary modifications, a field service bulletin shall be issued giving details of each modification and the reasoning for the particular modification.
 - p) Upon order placement provide and deliver spares to the specified sites or stores. Also notify Eskom where particular spares are no longer supplied and or provided.
 - q) Provide the specified training by the OEM accredited trainers as per document 240-56065202: Switchgear training from original equipment manufacturers.
 - r) Retaining spares for 25 years after discontinuance.
 - s) Any other responsibilities as set out in this standard.

13.2.3 Supplier's Responsibility Post Contract Award;

- a) Manufacturing the equipment on the awarded contract using drawings that show the Eskom allocated drawing number. The same drawings shall be issued to representatives of Eskom upon request during contract tenure.
- b) Inform Eskom on modifications, for approval and drawings and relevant documentation revisions.
- c) Unless otherwise specified in schedule A, the manufacturer shall submit the following documentation with each disconnector delivered to Eskom:
 - a schematic wiring diagram of the disconnector. This shall have the 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 contract number – for population after awarding of the contract;
 - a complete set of routine test certificates;
 - a commissioning and hand-over test sheet; and
 - one set of transport, storage, installation, operating and maintenance manuals

The above documents supplied with the disconnector shall be stored in the documentation pocket on the inside of the disconnector mechanism enclosure front access door.

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

13.3 Eskom's Responsibilities

13.3.1 Eskom shall be Responsible for the following:

- a) The supply of the specification and the completed schedule A with the enquiry.
- b) Undertake in-depth technical evaluations of tenders and the equipment offered, during the tendering phase including, when called for, perform evaluation at the manufacturer premises.
- c) Allocate Eskom numbers and approve drawings supplied by the contractor i.e. outline, wiring, main terminals, support structure interface (where applicable) and rating plate.
- d) Approve all documentation supplied by the supplier i.e. erection and maintenance instructions, manuals, inspection and test plans, training material, maintenance DVD and other supporting documents.
- e) Provide electrical power connection for heater energisation during storage.
- f) Provide storage if longer than scheduled time to installation is anticipated.

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- g) Provide the necessary, main conductor stringing, conductor clamps, secondary cabling, identification labels, connections to the substation earth mat and standard type padlocks.
 - h) Provide the steel support structure and civil foundation drawings for the disconnector and earthing switch.
 - i) Provide the steel support structure and civil foundation for the disconnector and earthing switch upon order placement.
 - j) In case of replacement of existing disconnectors, provide structural and civil details to the supplier in order to determine modifications to be made to the disconnector.
 - k) Supply and install all control, relaying and signalling equipment remote from the equipment.
 - l) When installation is done by the supplier, Eskom to witness and approve first off complete installation. This shall include testing and reports produced for the equipment.

13.4 Type Test Evidence

A summary of all the type tests performed on the equipment, indicating compliance with the requirements of this standard and SANS 62271-102. It shall include the testing authority and dates when type tests were performed.

13.5 Manuals

13.5.1 General

Transport, storage, installation (erection), operation and maintenance information shall be submitted in the form of manuals. These manuals shall be in English and provided in the following formats:

- a) Hard copy A4 form; and
- b) Electronic copy form copied onto an appropriate medium such as Compact Disc (CD), in PDF format.

The manual and contents shall be approved by Eskom. 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.

13.5.2 On Contract Awarding, Manuals shall be submitted as per Approved Schedule B.

13.5.2.1 Content

The instruction manual(s) shall cover transport, storage, installation, operation and maintenance and shall fulfil the following requirements:

- The manuals shall be written in English only;
- It shall be specifically compiled for the disconnector with which it has been supplied;
- Torque wrench settings, clearances, settings and other important information shall be listed, e.g. the typical operating times, speed curves and tolerances in synchronism;
- It shall give a clear description of the operation, and the diagrams and description shall be easily read together;
- Inspection), scheduled and specialised (intrusive) maintenance procedures shall be given together with a list of lubricants, recommended spares and/or special tools and so on, required for these operations;
- It shall contain high-quality diagrams showing details of operating components of the disconnector, which also identify and list separately each component making up the diagram;

- Seals and gaskets requiring replacement during overhaul shall be detailed and the suppliers of these components, together with the part number(s), shall be listed; and
- The names and addresses of suppliers of lubricants, oils, gases, and compounds and so on shall be listed.

13.5.2.2 Personnel

Qualified personnel will install, operate, maintain and repair the equipment with the aid of the manufacturer's instruction manuals and DVD aids. The manuals shall contain at least the following information (where applicable):

- 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 manual shall be sectionalised and numbered sequentially;
- equipment make and type to which the manuals apply;
- List of all drawings, by number and title;
- Description and summary of disconnector operation;
- Where applicable, details of interlocking between phases;
- Schematic wiring diagram of disconnector; and
- Where applicable, full details of all valves, including information regarding materials of valves and valve seals. If materials such as synthetic rubber or other equivalent types are used, the method of bonding or clamping these materials shall be given.

13.5.3 Transport and Storage Instructions

- Packaging requirements;
- 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.

13.5.4 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 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 disconnector on site; and
- Tolerances for field assembly.

The supplier shall supply a DVD to supplement installation information given in the installation manual. This visual information may be provided separately or may form part of the maintenance DVD required.

13.5.5 Testing

- functional testing, dielectric testing, 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.

13.5.6 Inspection and Maintenance

The maintenance manual shall contain the typical contents as described in 5.10.

13.5.7 Dismantling, Repair, Settings Inspection and Lubrication

- 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 gaskets, seals and O-rings 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 for the discharge of stored energies in the mechanical and electric systems; and
- Trouble-shooting procedures shall be provided.

13.5.8 Spare Parts

- Spare parts list, including quantities and manufacturer's part numbers. Spare part numbers shall be cross-referenced with drawings in the 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.

13.5.9 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 in c).

14. Training

The supplier shall provide first hand training of an international standard on the supplied equipment by OEM accredited instructors.

Refer to 240-56065202 for the switchgear training requirements from original equipment manufacturers.

15. Authorisation

This document has been seen and accepted by:

Name and surname	Designation
B Ntshangase	Senior Manager HV Plant
J Cebekhulu	AIS Care Group Convener
B Ntshangase	Plant Equipment SC Chairperson
	Rev 1 Document Approved by TDAC ROD 27 February 2013
	Rev 2 Document Approval via SCOT Chairman

16. Revisions

Date	Rev	Compiler	Remarks
Dec 2015	3	I Sibeko	Minor changes in the context and revision number and figure 1 updated.
June 2014	2	I Sibeko	Updated tables 1 & 2 and minor changes in clauses 3.18.1; 3.20.3 and 3.25.9
Aug 2013	1	I Sibeko	Final Document for Authorisation Updated document Final after Comments Review Updated document for Comments Review Updated all references from "this specification" to "this standard"; Included special requirements and designs that offer environmental friendliness. Updated all references from "this specification" to "this standard"; Included special requirements and designs that offer Environmental friendliness. Added on clause on Condition monitoring of disconnectors.
Nov 2012	0	I Sibeko	Draft document for Review created from ESP 32-536

17. Development team

The specification was revised by a cross functional team consisting of Eskom's Transmission & Distribution switchgear equipment specialists.

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

- Fanie Botha Transmission Free State Grid
- Isaac Sibeko Technology PDE HV Plant Engineering
- Grant Ruiters Transmission Northern Cape Grid
- Hennie de Bod Transmission Western Cape Grid
- Sphiwe Nkosi Technology PDE HV Plant Engineering
- John Orton Distribution Mpumalanga OU

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- Sarel Pretorius Transmission Central Grid
- Len Ludik Transmission Southern Grid.
- Almund Cilliers Distribution Mpumalanga OU
- Quinten Nepgen Transmission North East Grid
- Sipho Zulu Technology PDE Substation Engineering
- JD Fourie Transmission North West Grid
- TN Van Den Berg Transmission North West Grid
- Jack Wilson Distribution KZN OU
- Bernie Murfin QA CED 765kV Projects

18. Acknowledgements

The Compiler acknowledges the contributions to this revision from Technology, Distribution, Transmission and Quality.

Annex A – Technical Schedules A & B**Technical Schedules A and B for HV Outdoor disconnectors
(Generic)****Schedule A: Purchasers specific requirements****Schedule B: Guarantees and technical particulars of equipment offered**

1	2	3	4	5
Item	Clause of 240-56063815	Description	Schedule A	Schedule B
1		Purchasing details		
1.1		<input type="checkbox"/> Quantity of units required		XXXXXXXXXX
1.2		<input type="checkbox"/> SAP No		XXXXXXXXXX
1.3		<input type="checkbox"/> Region		XXXXXXXXXX
1.4		<input type="checkbox"/> Site Name		XXXXXXXXXX
1.5		<input type="checkbox"/> Nearest Town		XXXXXXXXXX
1.6		<input type="checkbox"/> Province		XXXXXXXXXX
1.7		<input type="checkbox"/> Distance from nearest town km		XXXXXXXXXX
1.8		<input type="checkbox"/> Access to site		XXXXXXXXXX
		<input type="checkbox"/>		
2		Delivery and off-loading		
2.1		<input type="checkbox"/> Disconnector delivered to:		XXXXXXXXXX
2.2		<input type="checkbox"/> Delivery effected not before Date		XXXXXXXXXX
2.3		<input type="checkbox"/> Erection completed not later than Date		XXXXXXXXXX
2.4		<input type="checkbox"/> Off-loaded from transport vehicle and transferred to intended operating position by supplier.	YES	
2.5		<input type="checkbox"/> Construction supply available		XXXXXXXXXX
		<input type="checkbox"/>		
3		Site conditions of service		
3.1		<input type="checkbox"/> Altitude m	1 800	
		<input type="checkbox"/> Ambient air temperature range		
3.2		<input type="checkbox"/> Maximum (Peak) °C	+45	
3.3		<input type="checkbox"/> Highest average daily °C	+35	

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1	2	3	4	5
Item	Clause of 240-56063815	Description	Schedule A	Schedule B
3.4		<input type="checkbox"/> Lowest average daily °C maximum	+5	
3.5		<input type="checkbox"/> Minimum °C	-10	
3.6		<input type="checkbox"/> Maximum average daily °C variation	25	
3.7		<input type="checkbox"/> Design level °C	50	
		<input type="checkbox"/>		
3.8		<input type="checkbox"/> Icing conditions	None	
		<input type="checkbox"/>		
3.9		<input type="checkbox"/> Humidity		
3.10		<input type="checkbox"/> Relative humidity conditions		
3.11		<input type="checkbox"/> Minimum %	5	
3.12		<input type="checkbox"/> Maximum %	99	
3.13		<input type="checkbox"/> Average %	50	
		<input type="checkbox"/>		
3.14		<input type="checkbox"/> Solar radiation W/m ²	1 100	
3.15		<input type="checkbox"/>		
3.16		<input type="checkbox"/> Wind loadings		
3.17		<input type="checkbox"/> Basic design velocity km/hr	115	
3.18		<input type="checkbox"/> Maximum wind speed km/hr	144	
3.19		<input type="checkbox"/> Wind loadings Pascals	1 000	
		<input type="checkbox"/>		
3.20		<input type="checkbox"/> Lightning flash density flashes/km ² /yr	8	
4		System conditions of service		
4.1		<input type="checkbox"/> Nominal system voltage kV		
4.2		<input type="checkbox"/> Number of phases	3	
4.3		<input type="checkbox"/> Nominal system frequency Hz	50	
4.4		<input type="checkbox"/> System earthing	Effectively earthed	
		<input type="checkbox"/>		

1	2	3	4	5
Item	Clause of 240-56063815	Description	Schedule A	Schedule B
5		Type of Disconnecter		
5.1		<input type="checkbox"/> Type of disconnector required	CRPDB / Pantograph	
		<input type="checkbox"/>		
6		Detail of disconnector		
6.1		<input type="checkbox"/> Manufacturer	xxxxxxxxxx	
6.2		<input type="checkbox"/> Type designation	xxxxxxxxxx	
6.3		<input type="checkbox"/> Number of breaks	xxxxxxxxxx	
6.4		<input type="checkbox"/> Main contacts	xxxxxxxxxx	
6.5		<input type="checkbox"/> Type	xxxxxxxxxx	
6.6		<input type="checkbox"/> Entry	Free/Friction	
6.7		<input type="checkbox"/> Contact force N	xxxxxxxxxx	
6.8		<input type="checkbox"/> Materials	xxxxxxxxxx	
6.9		<input type="checkbox"/> Wear allowance	xxxxxxxxxx	
		<input type="checkbox"/>		
7		<input type="checkbox"/> Disconnecter ratings (IEC 62271-102)		
7.1		<input type="checkbox"/> Rated nominal voltage kV	xxxxxxxxxx	
7.2		<input type="checkbox"/> Rated normal current A	xxxxxxxxxx	
7.3		<input type="checkbox"/> Rated short-time withstand current kA	xxxxxxxxxx	
7.4		<input type="checkbox"/> Rated duration of short circuit s	3	
7.5		<input type="checkbox"/> Rated peak withstand current kA	xxxxxxxxxx	
7.6		<input type="checkbox"/> Rated short-duration power frequency withstand voltage kV	xxxxxxxxxx	
7.7		<input type="checkbox"/> Rated lightning impulse withstand voltage kV	Xxxxxxxxxx	
8		<input type="checkbox"/> Mounting of disconnector		
8.1		<input type="checkbox"/> Upright, horizontal or vertical		
8.2		<input type="checkbox"/> Phase spacing mm	xxxxxxxxxx	
8.3		<input type="checkbox"/> Mounting height (lowest part of insulation above ground level) mm	xxxxxxxxxx	
8.4		<input type="checkbox"/> Arrangement of phases, in-line or transverse	Transverse / Clamping	

1	2	3	4	5
Item	Clause of 240-56063815	Description	Schedule A	Schedule B
8.5		<input type="checkbox"/> Is mounting structure for the isolator to be provided by the supplier	No	
8.6		<input type="checkbox"/> Is mounting structure for the separate earth switch to be provided by the supplier	Yes	
		<input type="checkbox"/>		
9		<input type="checkbox"/> Type of operation		
9.1		<input type="checkbox"/> Isolator	Hand / Motor	
9.2		<input type="checkbox"/> Earth switch	Hand	
10		<input type="checkbox"/> Operating movement (for hand driven mechanism)		
10.1		<input type="checkbox"/> Isolators	Horizontal	
10.2		<input type="checkbox"/> Earth switch	Horizontal	
11		<input type="checkbox"/> Motor driven mechanism		
11.1		<input type="checkbox"/> Motor voltage V	xxxxxxxxxx	
11.2		<input type="checkbox"/> Rated torque of drive Nm	xxxxxxxxxx	
11.3		<input type="checkbox"/> Maximum starting current A	xxxxxxxxxx	
11.4		<input type="checkbox"/> Operating times		
11.5		<input type="checkbox"/> Opening s	xxxxxxxxxx	
11.6		<input type="checkbox"/> Closing s	xxxxxxxxxx	
		<input type="checkbox"/>		
12		<input type="checkbox"/> Auxiliary switches		
12.1		<input type="checkbox"/> Number of contacts for disconnectors		
12.2		<input type="checkbox"/> Type G	10	
12.3		<input type="checkbox"/> Type GS	2	
12.4		<input type="checkbox"/> Type M	5	
12.5		<input type="checkbox"/> Type F	2	
12.6		<input type="checkbox"/> Type N	5	
12.7		<input type="checkbox"/> Number of contacts for earthing switches		
12.8		<input type="checkbox"/> Type M	4	

1	2	3	4	5
Item	Clause of 240-56063815	Description	Schedule A	Schedule B
12.9		<input type="checkbox"/> Type N	4	
13		<input type="checkbox"/> Ratings for auxiliary switches		
13.1		<input type="checkbox"/> Breaking current A		
13.2		<input type="checkbox"/> AC - 110 Volts (power factor 0,5) A	10	
13.3		<input type="checkbox"/> DC - 220 Volts (t=60 ms) A	2	
13.4		<input type="checkbox"/> Continuous current A	xxxxxxxxxx	
13.5		<input type="checkbox"/> Short-time current for 1 second ($t = 60$ ms)	100	
13.6		<input type="checkbox"/> Volt drop across contacts for a current of 10A DC mV		
		<input type="checkbox"/>		
14		<input type="checkbox"/> Main terminals		
14.1		<input type="checkbox"/> Type	Pad	
14.2		<input type="checkbox"/> Material	Aluminium	
14.3		<input type="checkbox"/> Orientation: vertical or horizontal		
14.4		<input type="checkbox"/> Dimension of pads:		
14.5		<input type="checkbox"/> Number of holes	8	
14.6		<input type="checkbox"/> Diameter of holes mm	14	
14.7		<input type="checkbox"/> Pitch of holes mm	50	
14.8		<input type="checkbox"/> Thickness of pad mm	xxxxxxxxxx	
		<input type="checkbox"/>		
15		Insulation and clearances		
15.1		<input type="checkbox"/> Details of insulators offered		
15.2		<input type="checkbox"/> Manufacturer	xxxxxxxxxx	
15.3		<input type="checkbox"/> Type designation	xxxxxxxxxx	
15.4		<input type="checkbox"/> Number of units in stack	xxxxxxxxxx	
15.5		<input type="checkbox"/> Cantilever strength class N	xxxxxxxxxx	
15.6		<input type="checkbox"/> Torsion strength Nm	xxxxxxxxxx	
15.7		<input type="checkbox"/> Creepage distance mm (minimum)	xxxxxxxxxx	
15.8		<input type="checkbox"/> Insulator material	Porcelain or silicon rubber	
		<input type="checkbox"/>		

1	2	3	4	5
Item	Clause of 240-56063815	Description	Schedule A	Schedule B
16		<input type="checkbox"/> Insulator test voltage		
16.1		<input type="checkbox"/> Lightning impulse withstand voltage (1,2/50 μ s) referred to sea level		
16.2		<input type="checkbox"/> To earth and between kV phases in the open position	xxxxxxxxxx	
16.3		<input type="checkbox"/> Across the isolating kV distance <input type="checkbox"/>	xxxxxxxxxx	
17		<input type="checkbox"/> Power frequency wet withstand voltage (60 second) referred to sea level		
17.1		<input type="checkbox"/> To earth and between kV phases in the open position	xxxxxxxxxx	
17.2		<input type="checkbox"/> Across the isolating kV distance	xxxxxxxxxx	
18		<input type="checkbox"/> Voltage test across isolating distance (bias test)		
18.1		<input type="checkbox"/> Value of power frequency kV voltage	xxxxxxxxxx	
18.2		<input type="checkbox"/> Crest value of lightning impulse wave	xxxxxxxxxx	
18.3		<input type="checkbox"/> Crest value of switching kV impulse wave	xxxxxxxxxx	
19		<input type="checkbox"/> Radio influence voltage test		
19.1		<input type="checkbox"/> Single phase test voltage kV applied to disconnector in open and closed position	xxxxxxxxxx	
19.2		<input type="checkbox"/> Radio influence voltage at 1 μ V MHz	xxxxxxxxxx	
20		<input type="checkbox"/> Electrical clearances		
20.1		<input type="checkbox"/> Between live portions of mm phases	xxxxxxxxxx	
20.2		<input type="checkbox"/> Between live portions at mm system voltage and earth	xxxxxxxxxx	
20.3		<input type="checkbox"/> Lowest point of insulation mm above ground level not to be less than	xxxxxxxxxx	
21		Miscellaneous		
21.1		<input type="checkbox"/> Mass details		

1	2	3	4	5
Item	Clause of 240-56063815	Description	Schedule A	Schedule B
21.2		<input type="checkbox"/> Complete disconnecter without earthing switch	kg	
21.3		<input type="checkbox"/> Complete disconnecter with single earthing switch	kg	
21.4		<input type="checkbox"/> Complete disconnecter with double earthing switch	kg	
21.5		<input type="checkbox"/> Separate earthing switch	kg	
22		<input type="checkbox"/> Protection of housing and mechanism boxes		
22.1		<input type="checkbox"/> International Protection rating	IP55	
22.2		<input type="checkbox"/> Material type	316 stainless steel	
23		<input type="checkbox"/> Cubicle heating and ventilation		
23.1		<input type="checkbox"/> Electrical heating		
23.2		<input type="checkbox"/> Supply voltage, 50 Hz V	230	
23.3		<input type="checkbox"/> Power rating W	xxxxxxxxxx	
24		<input type="checkbox"/> Secondary terminals, gland plate and cable connections		
24.1		<input type="checkbox"/> Terminal type		
24.2		<input type="checkbox"/> Manufacturer		
24.3		<input type="checkbox"/> Undrilled gland plate of Mm minimum usable area	xxxxxxxxxx	
24.4		<input type="checkbox"/> Control cable type used by Eskom	xxxxxxxxxx	
24.5		<input type="checkbox"/> Minimum distance between mm terminal board and gland plate	Xxxxxxxxxx	
25		<input type="checkbox"/> Supporting structures to be provided	No, unless part of construction	
26		<input type="checkbox"/> Testing authority certificates held to prove all ratings		
27		<input type="checkbox"/> Number of complete sets of instruction manuals and routine test results to be supplied with each equipment	One per equipment supplied in weather protective envelop inside mechanism door	

1	2	3	4	5
Item	Clause of 240-56063815	Description	Schedule A	Schedule B
28		<input type="checkbox"/> Number of complete sets of instruction manuals to be supplied on award of contract	10	
29		<input type="checkbox"/> Terminal mechanical loading		
29.1		<input type="checkbox"/> Maximum continuous loading:		
29.2		<input type="checkbox"/> Horizontal kN		
29.3		<input type="checkbox"/> 30° to horizontal kN		
29.4		<input type="checkbox"/> 60° to horizontal kN		
30		Documentation (to be submitted with tender) Note: All documentation to be provided in electronic format.		
30.1		<input type="checkbox"/> Type test certificates Sets	1	
30.2		<input type="checkbox"/> Outline drawings of Sets disconnectors	1	
30.3		<input type="checkbox"/> Wiring diagrams Sets	1	
30.4		<input type="checkbox"/> Operation and maintenance Sets manuals	1	

SIGNATURES

Supplier	Name (Print)	Sign	Date
Factory	Name (Print)	Sign	Date
Eskom	Name (Print)	Sign	Date

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