

 Eskom	Standard	Technology
--	-----------------	-------------------

Title: **DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**

Unique Identifier: **240-105506460**

Alternative Reference Number: **N/A**

Area of Applicability: **Engineering**





Documentation Type: **Standard**

Revision: **1**

Total Pages: **107**

Next Review Date: **July 2021**

Disclosure Classification: **Controlled Disclosure**

Compiled by	Approved by	Authorized by
		
Sphiwe Nkosi PDE HV Plant	Jabulani Cebekhulu AIS Care Group Convener	Bheki Ntshangase Senior Manager HV Plant
Date: 24/06/2016	Date: 28/06/2016	Date: 29/6/2016
		Supported by SCOT/SC
		
		Bheki Ntshangase Plant Equipment SC Chairperson
		Date: 29/6/2016

Content

	Page
1. Introduction.....	5
2. Supporting clauses.....	5
2.1 Scope.....	5
2.1.1 Purpose.....	5
2.1.2 Applicability.....	6
2.2 Normative/informative references.....	6
2.2.1 Normative.....	7
2.2.2 Informative.....	9
2.3 Definitions.....	9
2.3.1 General.....	9
2.3.2 Disclosure classification.....	13
2.4 Abbreviations.....	13
2.5 Roles and responsibilities.....	14
2.6 Process for monitoring.....	14
2.7 Related/supporting documents.....	14
3. Specification for Disconnecting circuit-breakers for System with Nominal Voltages from 66kV and above Standard.....	14
3.1 Ratings.....	14
3.1.1 Rated voltage (U_r) and number of phases.....	14
3.1.2 Rated insulation level.....	14
3.1.3 Rated frequency (f_r).....	15
3.1.4 Rated normal current (I_r) and temperature rise.....	15
3.1.5 Rated short-time withstand current (I_k).....	16
3.1.6 Rated peak withstand current (I_p).....	16
3.1.7 Rated duration of short circuit (t_k).....	16
3.1.8 Rated supply voltage of closing and opening devices and of auxiliary and control circuits (U_a).....	17
3.1.9 Rated short-circuit breaking current (I_{SC}).....	17
3.1.10 Transient recovery voltage related to the rated short-circuit breaking current.....	18
3.1.11 Rated short-circuit making current.....	18
3.1.12 Rated operating sequence.....	18
3.1.13 Characteristics for short-line faults.....	19
3.1.14 Rated out-of-phase making and breaking current.....	19
3.1.15 Rated capacitive switching current.....	19
3.1.16 Inductive load switching.....	20
3.1.17 Rated time quantities.....	20
3.1.18 Number of mechanical operations.....	21
3.1.19 Classification of Disconnecting circuit-breakers as a function of electrical and mechanical endurance.....	21
3.2 Design and construction.....	22
3.2.1 Service conditions.....	22
3.2.2 General.....	22
3.2.2.2 Interlocking device requirement.....	24
3.2.2.3 Integral earthing switch requirement.....	24
3.2.2.4 The maintenance outage disconnecting device requirement.....	25

ESKOM COPYRIGHT PROTECTED

3.2.3	Construction requirements	25
3.2.4	DCB operating mechanism enclosure requirements	25
3.2.5	Rated static terminal load and dynamic forces on DCB and its support structure and foundation	27
3.2.6	Corrosion protection and lubrication	29
3.2.7	Terminal requirements	31
3.2.8	Safety clearances and personnel safety	31
3.2.8.1	Securing of position requirement	32
3.2.9	Insulation requirements	32
3.2.10	Position indication (status indication)	34
3.2.11	Labels	35
3.2.12	Requirements for sulphur hexafluoride (SF6) gas (where applicable)	35
3.2.13	Current transformers (CTs) for dead-tank Disconnecting circuit-breakers	37
3.2.14	Switching surge control (where applicable)	39
3.2.15	Grading capacitors (where applicable)	40
3.2.16	Extreme asymmetrical short-circuit interrupting capability (where applicable)	40
3.2.17	Requirements for simultaneity of poles during single closing and single opening operations	40
3.2.18	Controlled switching	41
3.2.19	Pole discordance (PD) or phase discrepancy	41
3.2.20	Auxiliary and control circuits	42
3.2.21	Nameplates	44
3.2.22	Tools and spares	45
3.2.23	Documentation requirements	45
3.2.24	Packaging and preservation requirements	48
3.3	Tests	50
3.3.1	General	50
3.3.2	Type and routine test requirements	51
3.3.3	Tests after installation on site (pre-commissioning tests)	54
3.4	Manufacturing, transport, storage, installation, pre-commissioning and after sales technical support	55
3.4.1	General	55
3.4.2	Inspection of manufacturing facilities and Disconnecting circuit-breakers	55
3.4.3	Conditions during transportation	56
3.4.4	Transportation and off-loading	56
3.4.5	Storage and preservation	56
3.4.6	Installation	57
3.4.7	Pre-commissioning	58
3.4.8	Safety related data (where applicable)	59
3.4.9	Requirements for pressure vessels (where applicable)	59
3.4.10	After sales technical support	60
3.5	Inspection and maintenance	60
3.5.1	General	60
3.5.2	Maintenance DVD	61
3.5.3	Spares	62
3.5.4	Modifications to Disconnecting circuit-breakers during their service life	63
3.5.5	Condition monitoring of Disconnecting circuit-breakers	64
3.5.6	Technical non-conformance on the DCB during its service life	64
3.6	Manuals	64

3.6.1	General	64
3.6.2	Content.....	65
3.7	Training	67
3.8	Safety, health, environment and quality	67
4.	Authorisation.....	67
5.	Revisions	67
6.	Development team	67
7.	Acknowledgements	68
Annex A – Supplier and Eskom responsibilities		69
A.1.1) Eskom requirements for technical evaluation.....		69
A.1.1.1) Minimum requirements for technical evaluation		69
Annex B – Technical Schedule A & B (Generic) – DO NOT POPULATE THIS.....		75
Annex C – TECHNICAL SCHEDULES A & B for PIUs in accordance with EST 240-64685228.....		94
Annex D – Maintenance Analysis		105

Figures

Figure 1: Typical arrangement of the DCB specified by this Eskom standard	5
Figure 2: Typical arrangement of the CTs on the dead-tank DCB	37

Tables

Table 1: Rated voltage and insulation levels	15
Table 2: Standardised rated normal currents (I_r)	16
Table 3: Standardised rated short circuit-breaking, short-time and peak withstand currents	17
Table 4: Classification of Disconnecting circuit-breakers (SANS 62271-100)	21
Table 5: Eskom standard civil design drawings for outdoor live-tank circuit-breaker steel support structures and concrete foundations	29
Table 6: Material and Corrosion Protection Information	29
Table 7: Minimum electrical working clearances	31
Table 8: Minimum creepage distances (USCD and SCD) and the SPS class.....	33
Table 9: 765kV ratios for multi ratio (MR) and fixed metering current transformers	38
Table 10: 765kV ratios for multi ratio (MR) and fixed protection current transformers.....	38
Table 11: Values where TPY cores are used on dead-tank Disconnecting circuit-breakers	38
Table 12: Values for the 765kV Reactor dead-tank DCB	39
Table A.1: The Returnables Tick-sheet to be completed by each Supplier/ Tenderer	69
Table D.1: FMECA Worksheet	106
Table D.2: Maintenance Requirements Definition	107

1. Introduction

This standard sets out Eskom's specific and standardised requirements for Disconnecting circuit-breakers for use in three-phase 50 Hz alternating current systems with nominal voltages from 66 kV up to and including 500 kV. The requirements for Disconnecting circuit-breakers are based on SANS 62271-108 (High-voltage alternating-current Disconnecting circuit-breakers for rated voltages 72.5 kV and above). The form of the DCB specified by Eskom shall be in accordance with SANS 62271-108, Annex A, Figure A.1.

The standard covers both live-tank and dead-tank Disconnecting circuit-breakers. The Disconnecting circuit-breakers may be specified with or without current transformers (CTs). The DCB designs that offer environmental friendliness and meet this standard shall be considered. These shall have been designed and type-tested in accordance with SANS 62271-108 standard, and shall be shall fulfil all the applicable requirements of the SANS 62271-100 and SANS 62271-102.

Neither pre-insertion resistors nor grading capacitors bridging the isolating distance shall be accepted.

Where the earthing switch is integral to the DCB, it shall be compliant to this Eskom standard and the standard for disconnectors, 240-56063815.

Note: In special cases this standard shall be used for high voltage DC applications, e.g. traction, DC bypass bridges, DC-pole switching, whereby a separate technical schedule A and B shall be issued. The details of the switchgear application on the HVDC scheme shall be clarified.

2. Supporting clauses

2.1 Scope

2.1.1 Purpose

This standard provides the specific and standardised requirements for Disconnecting circuit-breakers in accordance with SANS 62271-108.

The form of the DCB specified by Eskom shall be in accordance with SANS 62271-108, Annex A, Figure A.1 - A making (breaking) unit (or several identical units connected in series) which satisfies the dielectric requirements of a disconnector. As per redrawn illustration Figure 1 below:-

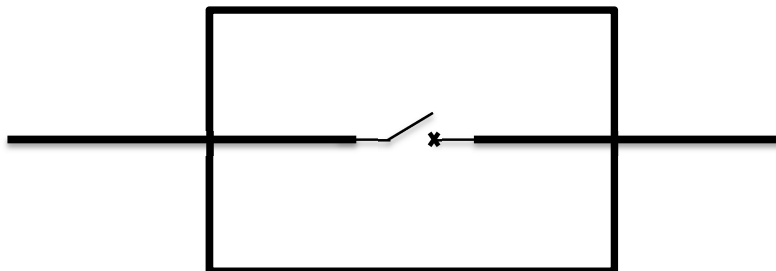


Figure 1: Typical arrangement of the DCB specified by this Eskom standard

The Disconnecting circuit-breakers are intended for use in substations having three-phase 50 Hz alternating current (a.c.) nominal operating voltages from 66 kV and above. Disconnecting circuit-breakers are required for general purpose power switching and protection applications as well as for special purpose applications such as the switching of earthed shunt capacitor banks, shunt reactors, line reactor, line reactor bypassing, capacitor-reactor combinations and generator unit synchronising. In special cases this standard shall be used for other high voltage applications, e.g. series capacitor bypass, traction, DC bypass bridges, DC-pole switching, whereby a separate technical schedule A and B shall be issued.

Neither pre-insertion resistors nor grading capacitors bridging the isolating distance shall be accepted.

The standard covers both live-tank and dead-tank Disconnecting circuit-breakers. The Disconnecting circuit-breakers may be specified with or without current transformers (CTs). The DCB designs that offer environmental friendliness and meet this standard shall be considered. These shall have been designed and type tested in accordance with IEC62271-108 standard.

Where the earthing switch is integral to the DCB, it shall be compliant to this standard and the Eskom's, 240-56063815, High Voltage Outdoor Disconnectors and earthing switches standard and the standard for disconnectors..

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

The standard covers the design, manufacture, testing, supply, delivery, storage, installation, pre-commissioning and guarantee of Disconnecting circuit-breakers and associated equipment specified herein.

This standard includes the requirement for the full detailed maintenance analysis FMECA (Annex D). It also includes the option of the digital secondary plant interface (Annex C).

The Supplier responsibilities for tender are contained under Annex A, clause A.1. Therein the details of the minimum documentation required for technical evaluation of the tender are listed. The Supplier shall populate the Table A.1 with all submitted returnables for the purpose of the technical evaluation of the tender submission.

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.

2.2.1 Normative

NOTE: IEC standards (SANS documents are IEC documents adopted as SANS standards)

- [1] SANS 60137, Insulated bushings for voltages above 1000V
- [2] SANS 60044-1, Current Transformers
- [3] SANS 60044-6, Current Transformers – Part 6: Requirements for protective current transformers for transient performance
- [4] SANS 60060-1, High-voltage test techniques — Part 1: General definitions and test requirements.
- [5] IEC 60073, Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators
- [6] IEC 60376, Specification of technical grade sulphur hexafluoride (SF6) for use in electrical equipment.
- [7] IEC 60447, Basic and safety principles for man-machine interface, marking and identification – Actuating principles
- [8] SANS 60529, Degrees of protection provided by enclosures (IP code)
- [9] SANS 60815-1:2009, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles.
- [10] SANS 60815-2:2009, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 2: Ceramic and glass insulators for a.c. systems.
- [11] SANS 60815-3:2009, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems.
- [12] SANS 61462, Composite hollow insulators — Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V — Definitions, test methods, acceptance criteria and design recommendations.
- [13] SANS 62155, Hollow pressurized and unpressurized ceramic and glass insulators for use in electrical equipment with rated voltages greater than 1 000 V.
- [14] SANS 62271-1, High-voltage switchgear and controlgear – Part 1: Common specifications.
- [15] SANS 62271-100, High-voltage switchgear and controlgear – Part 100: High-voltage alternating-current Disconnecting circuit-breakers.
- [16] SANS 62271-102, High-voltage switchgear and controlgear – Part 102: High-voltage alternating-current disconnectors and earthing switches.
- [17] SANS 62271-108, High-voltage alternating-current Disconnecting circuit-breakers for rated voltages 72.5 kV and above.
- [18] SANS 62271-110, High-voltage switchgear and controlgear – Part 110: Inductive load switching.
- [19] SANS 62271-203, High-voltage switchgear and controlgear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV.
- [20] SANS 62271-300, High-voltage switchgear and controlgear – Part 300: Guide for seismic qualification of alternating current Disconnecting circuit-breakers.
- [21] SANS 62271-301, High-voltage switchgear and controlgear – Part 302: Dimensional standardisation of high-voltage terminals.
- [22] SANS 62271-302, High-voltage switchgear and controlgear – Part 302: Alternating current Disconnecting circuit-breakers with intentionally non-simultaneous pole operation.
- [23] SANS 62271-305, High-voltage switchgear and controlgear – Part 305: Capacitive current switching capability of air-insulated disconnectors for rated voltages above 52 kV

-
- [24] SANS 62271-310, High-voltage switchgear and controlgear – Part 310: Capacitive current switching capability of air-insulated disconnectors for rated voltages above 52 kV.
 - [25] ISO/IEC 17025, General requirements for the competence of testing and calibration laboratories
 - [26] Occupation Health and Safety Act (OHS Act) No 85 of 1993 – Construction and Electrical Machinery Regulations.
 - [27] NRS 087, Guidelines for the management of SF6 (sulphur hexafluoride) for use in electrical equipment.
 - [28] SANS 121, Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods
 - [29] SANS 1091, National colour standard.
 - [30] SANS 10684, Fasteners – Hot dip galvanized coatings
 - [31] SANS/ IEC 6189-1, Instrument transformers – Part 1 General requirements.
 - [32] SANS 61850/ IEC 61850, (All parts) Communication networks and systems for power utility automation.
 - [33] SANS 62271-3/ IEC 62271-3, High-voltage switchgear and controlgear — Part 3: Digital interfaces based on IEC 61850.
 - [34] 240-42066934/ IEC 61850, Protocol implementation document for the purposes of substation automation.
 - [35] 240-64685228, Generic specification for protective Intelligent Electronic Devices (IEDs).
 - [36] 240-68107841 Eskom IEC61850 standard requirements for PICS, PIXIT and TICS.
 - [37] 240-68235024 Eskom IEC 61850 station bus interoperability test standard.
 - [38] ESP 32-846: Operating Regulations for High Voltage Systems (ORHVS).
 - [39] NRS 029, Current transformers for rated a.c. voltages from 3,6 kV up to and including 420 kV (maximum voltage for equipment).
 - [40] 240-56063815, High Voltage Outdoor Disconnectors and earthing switches standard and the standard for disconnectors
 - [41] 240-56062328, Distribution Standard Part 0: KIPTS natural ageing and pollution performance test procedure for outdoor insulator products section 0 – general requirements.
 - [42] 240-56062515 (DISSCAAK9), Distribution Standard Part 15: Specification for labels on control panels, relay panels and other indoor and outdoor equipment.
 - [43] DSP 34-1658, Distribution Standard Part 4: Corrosion protection specification for new indoor and outdoor Distribution equipment manufactured from steel.
 - [44] 240-56065202, Distribution Standard Part 7: Switchgear training requirements from original equipment manufacturers.
 - [45] 240-56030489, Distribution Standard Part 7: Standard requirements for the wiring of outdoor switchgear used in systems of nominal voltage up to and including 132 kV.
 - [46] QM-58, Supplier contract quality requirements specification.
 - [47] 240-56063765, Eskom health and safety management – supplier requirements.
 - [48] Technical Bulletin: 06TB-027: CAP's Requirements For KIPTS Test reports.
 - [49] DST_240-53902499, Standard for the transport, handling, storage and preservation of HV and MV switchgear.
 - [50] 240-56062864, Current transformers Eskom specific requirements up to 132kV in accordance with NRS 029 standard.

-
- [51] Annex A – Supplier and Eskom’s responsibilities.
 - [52] Annex B – Technical Schedules.
 - [53] Annex C – Technical Schedules for the digital secondary plant interface.
 - [54] Annex D – Maintenance Analysis.
 - [55] D-DT-5200-1, Outdoor 132 kV circuit-breaker foundation details.
 - [56] D-DT-5200-2, Outdoor 66/132 kV circuit-breaker support details.
 - [57] D-DT-5201, Outdoor 66 kV circuit-breaker foundation details.
 - [58] D-DT-5407, Wiring of outdoor Disconnecting circuit-breakers up to and including 132 kV.
 - [59] 0.54/7471-0-0, 275 kV circuit-breaker foundation details.
 - [60] 0.54/7472-0-0, 400 kV circuit-breaker foundation details.
 - [61] 0.54/7479-0-0, 275 kV and 400 kV circuit-breaker support details.
 - [62] 0.54/07529, Wiring of outdoor 220 kV, 275 kV, 400 kV and 765kV Live Tank Disconnecting circuit-breakers.
 - [63] 0.54/8557, Wiring of outdoor 220 kV, 275 kV, 400 kV and 765kV Dead Tank Disconnecting circuit-breakers.
 - [64] 240-46425564, Technical evaluation criteria for High Voltage Switchgear standard.
 - [65] 240-86739185, Maintenance Standard for SF6 Outdoor Circuit Breakers
 - [66] 240-84698553: Maintenance standard for Gas Insulated Switchgear (GIS) and Mixed Technology Switchgear (MTS) substation

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
breakdown maintenance	Unplanned (or unscheduled) maintenance work required to repair a fault and thus restore the switchgear and controlgear to an acceptable condition after a failure
circuit-breaker	[SANS 62271-108 definition 3.4.101] Mechanical switching device, capable of making, carrying and breaking currents under normal circuit conditions and also making, carrying for a specified time and breaking currents under specified abnormal circuit conditions such as those of short circuit [IEV 441-14-20]
circuit-breaker class C1	[SANS 62271-100 definition 3.4.114] Circuit-breaker with low probability of restrike during capacitive current breaking as demonstrated by specific type tests
circuit-breaker class C2	[SANS 62271-100 definition 3.4.115] Circuit-breaker with very low probability of restrike during capacitive current breaking as demonstrated by specific type tests

ESKOM COPYRIGHT PROTECTED

Definition	Description
Circuit-breaker class E2 (circuit-breaker with extended electrical endurance)	[SANS 62271-310 definition 3.1] Circuit-breaker designed so as not to require maintenance of the interrupting parts of the main circuit during its expected operating life Note: "Expected operating life" in this definition means a minimum period of use without maintenance of the interrupting parts. Normally the life expectancy of the design is higher.
circuit-breaker class M1	[SANS 62271-100 definition 3.4.116] Circuit-breaker with normal mechanical endurance demonstrated by specific type tests
circuit-breaker class M2	[SANS 62271-100 definition 3.4.117] Frequently operated circuit-breaker for special service requirements and designed so as to require only limited maintenance as demonstrated by specific type tests
closed position (of a mechanical switching device)	[SANS 62271-108 definition 3.6.101] Position in which the predetermined continuity of the main circuit of the device is secured [IEV 441-16-22]
Corrective Maintenance	The maintenance carried out after a failure has occurred and intended to restore an item to a state in which it can perform its required function
disconnecting circuit-breaker (DCB)	[SANS 62271-108 definition 3.4.103] Circuit-breaker satisfying the requirements of a disconnector, when the contacts are in open position
disconnector	[SANS 62271-108 definition 3.4.102] Mechanical switching device which provides, in the open position, an isolating distance in accordance with specified requirements [IEV 441-14-05] [Additional Notes from SANS 62271-102 definition 3.4.104] Note 1: "Negligible current" implies currents such as the capacitive currents of bushings, busbars, connections, very short lengths of cable, currents of permanently connected grading impedances of Disconnecting circuit-breakers and currents of voltage transformers and dividers (see also IEC 62271-305). For rated voltages of 420 kV and below, a current not exceeding 0,5 A is a negligible current for the purpose of this definition; for rated voltage above 420 kV and currents exceeding 0,5 A, the manufacturer should be consulted. "No significant change in voltage" refers to such applications as the by-passing of induction voltage regulators or Disconnecting circuit-breakers and bus transfer. Note 2: For a disconnector having a rated voltage of 52 kV and above, a rated ability of bus transfer current switching may be assigned.
disconnector class M0	[SANS 62271-102 definition 3.4.101.1] Disconnector having a mechanical endurance of 1 000 operating cycles, suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard
disconnector class M1	[SANS 62271-102 definition 3.4.101.2] Disconnector having an extended mechanical endurance of 2 000 operating cycles, mainly for applications where the disconnector is operated in conjunction with a circuit-breaker of an equal class

Definition	Description
disconnecter class M2	[SANS 62271-102 definition 3.4.101.3] Disconnecter having an extended mechanical endurance of 10 000 operating cycles, mainly for applications where the disconnecter is operated in conjunction with a circuit-breaker of an equal class
earthing switch	[SANS 62271-102 definition 3.4.105] IEV 441-14-11 is applicable with the following additional notes: Note 101: An earthing switch having a rated voltage of 52 kV and above may have a rating for switching and carrying induced currents. Note 102: These devices may sometimes be operated against short-circuit. The different classes of earthing switches are related to the number of short-circuit making operations. Note 103: For special applications such as fault initiating earthing switches the test procedures and the number of tests may be agreed upon between the manufacturer and the user.
earthing switch class E0	[SANS 62271-102 definition 3.4.105.1] Earthing switch suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard, without a short-circuit making capability
earthing switch class E1	[SANS 62271-102 definition 3.4.105.2] Earthing switch suitable for applications in distribution and transmission systems fulfilling the general requirements of this standard, with the capability to withstand two short-circuit making operations Note: This class of earthing switch is able to withstand two making operations at rated making current.
external insulation	[SANS 62271-108 definition 3.7.102] Distances in atmospheric air, and surfaces of solid insulation of disconnectors and earthing switches in contact with the air, which are subject to dielectric stresses and to the effect of atmospheric and other external conditions such as pollution, humidity, vermin, etc. [IEV 604-03-02, modified] Note: External insulation is either weather-protected or non-weather-protected, designed to operate outside or inside closed shelters, respectively
inspection	[SANS 62271-1 definition 3.1.8] Visual investigation of the principal features of the switchgear and controlgear in service without dismantling
insulation level	[SANS 62271-108 definition 3.7.101] For a disconnecting circuit-breaker, a characteristic defined by one or two values indicating the insulation withstand voltages [IEV 604-03-47, modified]
Intelligent Electronic Device (IED)	A device incorporating one or more processors with the capability to execute application functions, store data locally in a memory and exchange data with other IEDs (sources or sinks) over a digital link [IEC 61850-5].
interlocking device	[SANS 62271-108 definition 3.6.103] Device which makes the operation of a switching device dependent upon the position of operation of one or more other pieces of equipment [IEV 441-16-49]

Definition	Description
internal insulation	[SANS 62271-108 definition 3.7.103] Internal solid, liquid or gaseous parts of the insulation of equipment which are protected from the effects of atmospheric and other external conditions [IEV 604-03-03]
isolating distance (of a pole of a mechanical switching device)	[SANS 62271-108 definition 3.7.104] Clearance between open poles meeting the safety requirements specified for disconnectors [IEV 441-17-35, modified]
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 controlgear 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.
minor maintenance	The execution of scheduled or preventive maintenance work in accordance with the manufacturer's maintenance manual and requiring the switchgear and controlgear to be taken out of service (i.e. in a down state). Notes: 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 circuit-breaker 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
open position (of a mechanical switching device)	[SANS 62271-108 definition 3.6.102] Position in which the predetermined clearance between open contacts in the main circuit of the device is secured [IEV 441-16-23]
overhaul	[SANS 62271-1 definition 3.1.11] Work performed with the objective of repairing or replacing parts which are found to be out of tolerance by inspection, test, examination, or as required by manufacturer's maintenance manual, in order to restore the component and/or the switchgear and controlgear to an acceptable condition (within tolerance)
power kinematic chain	[SANS 62271-100 definition 3.4.125] Mechanical connecting system from and including the operating mechanism up to and including the moving contacts Note: See also A.3.5.111 of IEC 62271-102.
Process Interface Unit (PIU)	Also referred to as a 'digital merging unit' or 'binary input/output device'; an Intelligent Electronic Device (IED) that collects binary data from process devices, typically electrical primary plant equipment, by way of status contacts, and processes and publishes this data to other IEDs in a digital format (e.g. IEC 61580-based communication). The device similarly converts digital commands from other IEDs into electrical control signals to the primary equipment.

Definition	Description
routine inspection	Visual investigation of the principal features of the switchgear and controlgear in service without dismantling. Notes: 1) This inspection is generally directed toward pressures and/or levels of fluids, tightness, position of relays, pollution of insulating parts, but actions such as lubricating, cleaning, washing, etc. which can be carried out with the switchgear and controlgear in service are also included. 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.
scheduled maintenance	[SANS 62271-1 definition 3.1.7] Preventive maintenance carried out in accordance with an established time schedule [IEV 191-07-10]
specialised tools	Any purpose-built tools that are necessary to carry out major (or specialised) maintenance on a circuit-breaker and its components
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
ACSI	Abstract Communication Service Interface [IEC 61850-7-2]
AMSL	Above mean sea level
ARC	Auto re-closing
DN20	20 mm SF6 coupling. D = Diameter, N = Nominal and 20 = 20 mm inside diameter to determine the gas flow capacity. Coupling thread size is M 45 x 2
DN8	8 mm SF6 coupling. D = Diameter, N = Nominal and 8 = 8 mm inside diameter to determine the gas flow capacity. Coupling thread size is M 26 x 1,5.
FMECA	Failure Modes, Effects and Criticality Analysis
GOOSE	Generic Object Oriented Substation Event [IEC 61850-8-1]
OEM	Original equipment manufacturer
PDE	Power Delivery Engineering
QITP	Quality Inspection and Test Plans
SCD	Specific creepage distance
SPS class	Site Pollution Severity class
USCD	Unified specific creepage distance

2.5 Roles and responsibilities

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

The detailed list of Supplier and Eskom responsibilities are covered under Annex A.

2.6 Process for monitoring

Not applicable.

2.7 Related/supporting documents

Technical A & B schedules.

3. Specification for Disconnecting circuit-breakers for System with Nominal Voltages from 66kV and above Standard

3.1 Ratings

3.1.1 Rated voltage (U_r) and number of phases

- a) The rated voltage of Disconnecting circuit-breakers shall be in accordance with the values given in 1. The rated voltage required will be specified in schedule A. The rated voltage offered shall be stated in schedule B.

Note 1: The nominal system voltages (U_n) in Eskom are 6,6 kV, 11 kV, 22 kV, 33 kV, 44 kV, 66 kV, 88 kV, 132 kV, 220 kV, 275 kV, 400 kV and 765 kV.

Note 2: In special cases this standard shall be used for high voltage DC applications, e.g. series capacitor bypass, traction, DC-bypass bridges, DC-pole switching, whereby a separate technical schedule A and B shall be issued. The nominal system voltage for HVDC scheme is +/-533kV DC, the Thyristor Bridges and poles are rated for 133.3kV DC.

- b) The number of phases shall be three.

3.1.2 Rated insulation level

The rated insulation levels of Disconnecting circuit-breakers shall be in accordance with the values given in 1. The rated insulation levels offered shall be stated in schedule B. No additional altitude correction factors need be applied for equipment installed up to 1800 m AMSL.

The insulation test under dry and wet conditions shall be in accordance with SANS 62271-1 clause 6.2. The wet conditions test shall be required for DCB's specified by Eskom since they are meant for outdoor application.

The DCB shall also be tested in accordance with SANS 62271-108 clause 5.102, to fulfil the requirements in respect of the isolating distance of DCB in service. The Supplier shall provide, with the tender documentation, the proof of insulation testing upon such conditions as could arise during service, namely; loss of SF6 pressure, contamination of SF6 gas caused by wear and arcing by-products, both wet and polluted conditions.

Table 1: Rated voltage and insulation levels

Nominal system voltage U_n [kV (r.m.s.)]	Rated voltage [kV (r.m.s.)]	Rated short-duration power-frequency withstand voltage U_d [kV (r.m.s.)] _{Ur}		Rated lightning impulse withstand voltage U_p [kV (peak)]		Rated switching impulse withstand voltage U_s [kV (peak)]	
		Phase-to-earth and between phases	Across open switching device	Phase-to-earth and between phases	Across open switching device	Phase-to-earth and across open switching device	Between phases
66	72,5	140	160	325	375	-	-
132	145	275	315	650	750	-	-
132 (rated for 170)	170	325	375	750	860	-	-
275	300	395	435	1050	1050 (+170)	850	1275
400	420	520	610	1425	1425 (+240)	1050	1575
400 & 550	550 ^{b)}	620	800	1550	1550 (+315)	1175	1760
765	800	830	1150	2100	2100 (+455)	1550	2480
+/- 533 DC	^{h)}						

Notes:

- 1) In this table, the withstand voltages apply at the standardised reference atmosphere (temperature, pressure and humidity) in accordance with SANS 62271-1.
- 2) The information in this table is based on SANS 1019 and SANS 62271-1.
- 3) The specification of the insulation levels given in this Table is based on the SANS 1019 philosophy – i.e. by the judicious selection of protective devices and their location with respect to equipment to be protected, it is generally possible to adopt the same insulation level for internal insulation and external insulation for equipment suitable for use at altitudes up to 1 800 m AMSL (Above Mean Sea Level). This enables manufacturers and users to adopt internationally accepted designs for use in South Africa.
- 4) No additional altitude correction factors need be applied for equipment installed up to 1800 m AMSL.
- 5) The power frequency withstand test under wet conditions is required for outdoor Disconnecting circuit-breakers rated for $U_r \leq 245$ kV
- 6) The Disconnecting circuit-breakers specified for 550kV rating shall also be installed on Eskom's 400kV network upon special requirements.
- 7) The Disconnecting circuit-breakers required for generator synchronising, shall be provided with proof of having passed the power frequency withstand (Wet conditions) in accordance with IEC 60060-1. It shall also be demonstrated that they are suitable to withstand the overvoltage and switching transients upon a system condition when the generator is being synchronised out-of-phase, up to 180 °, during polluted and wet conditions.
- 8) The Disconnecting circuit-breakers specified for DC application shall be installed on Eskom's +/- 533kV HVDC network upon special requirements. The voltage across open contacts is 133.3 kV DC rating.

3.1.3 Rated frequency (f_r)

The rated frequency shall be 50 Hz.

3.1.4 Rated normal current (I_r) and temperature rise

- a) The rated normal current of Disconnecting circuit-breakers shall be 2500 A, 3150 A and 4000 A.
- b) The rated normal current required will be specified in schedule A. The rated normal current offered shall be stated in schedule B.
- c) The standard rated normal currents of Disconnecting circuit-breakers are given in 2.

ESKOM COPYRIGHT PROTECTED

Table 2: Standardised rated normal currents (I_r)

Nominal system voltage Un [kV]	Rated normal current (I_r) [A]				
	1600	2000	2500	3150	4000
66	-	-	x ¹⁾	x ²⁾	-
88	-	-	x ¹⁾	x ²⁾	-
132	-	-	x ¹⁾	x ²⁾	-
132 (rated for 170)	-	-	x ¹⁾	x ²⁾	-
220	-	-	x	x	-
275	-	-	x	x	x
400	-	-	-	x	x ³⁾
500	-	-	-	x	x
765	-	-	-	x	x
+/- 533 DC			1800 DC x ⁴⁾		
Notes: 1) Required for Distribution substation applications (HV sub-transmission and MV Distribution networks). Rationalisation of a 3150 A DCB may be considered, when commercially viable. 2) Required for Transmission substation applications. 3) Same rating shall be applicable to the 550kV rated DCB requirement 4) For Eskom's +/- 533kV HVDC system requirement, the rated normal current shall be 1800A DC as a minimum. It shall be demonstrated if the DCB can carry the current of 3300A upon emergency or future requirements.					

- d) The associated temperature rise limits for the rated normal current shall be in accordance with SANS 62271-1 Table 15.
- e) Based on the actual results of the DCB temperature rise type testing, the calculated maximum continuous current that the DCB can carry, without exceeding the maximum allowable temperatures for the major components, shall be stated in schedule B for a maximum ambient temperature of i) 40 °C and ii) 45 °C (refer to a)).
- f) Based on the actual results of the DCB temperature rise type testing, the highest measured temperature rise values for the major components (refer to SANS 62271-1 Table 15) when carrying rated current shall be stated in schedule B.

3.1.5 Rated short-time withstand current (I_k)

The rated short-time withstand current of Disconnecting circuit-breakers shall be in accordance with the values given in Table 3. The rated short-time withstand current required will be specified in schedule A. The rated short-time withstand current offered shall be stated in schedule B.

3.1.6 Rated peak withstand current (I_p)

The rated peak withstand current of Disconnecting circuit-breakers shall be in accordance with the values given in Table 3. The rated peak withstand current required will be specified in schedule A. The rated peak withstand current offered shall be stated in schedule B.

3.1.7 Rated duration of short circuit (t_k)

The rated duration of the short circuit (t_k) shall be 3 seconds.

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

Nominal system voltage U_n [kV]	Rated short-circuit breaking and short-time (3 sec) withstand current ISC, Ik [kA (r. m. s.)]	Rated peak withstand current I_p [kA (peak)]
66	20 / 25 / 31,5	50 / 62,5 / 78,75
88 ^{*)}	20 / 25 / 31,5	62,5 / 78,75
132	25 / 31,5 / 40	62,5 / 78,75 / 100
132 (rated 170kV)	25 / 31,5 / 40	62,5 / 78,75 / 100
220 ^{*)}	31,5 / 40 / 50	78,75 / 100 / 125
275	40 / 50	100 / 125
400 ^{**)}	50 / 63	125 / 157,5
765	50	125
+/- 533 DC ^{***)}	20	50

^{*)} - denotes that for 88kV and 220kV networks, the rated Disconnecting circuit-breakers of one level higher rating are employed.

^{**)} - denotes that both 420kV and 550kV rated Disconnecting circuit-breakers are required to meet this criteria

^{***)} - denotes that the +/- 533kV DC rated Disconnecting circuit-breakers are required to meet this minimum criteria. The voltage across open gap is 133.3kV DC

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

- The rated d.c. supply voltage (U_a) of closing and opening devices and of auxiliary and control circuits shall be 110 V or 220 V. The rated d.c. supply voltage required will be specified in schedule A.
- The rated a.c. supply voltage (U_a) of heaters and other a.c. auxiliary circuits shall be single-phase 230 V.

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

The rated supply frequency of heaters and other a.c. auxiliary circuits shall be 50 Hz.

3.1.9 Rated short-circuit breaking current (I_{sc})

- The rated short-circuit breaking current (I_{sc}) of Disconnecting circuit-breakers shall be equal in value to the rated short-time withstand current (I_k) specified in 3. The rated short-circuit breaking current required will be specified in schedule A. The rated short-circuit breaking current offered shall be stated in schedule B.
- Under certain system neutral earthing conditions, the single-phase (phase-to-earth) fault level may exceed the three-phase (phase-to-phase) symmetrical fault level and a higher single-phase-to-earth rated short-circuit breaking current may be required. The factor (up to 1,15) by which the 100 % symmetrical and asymmetrical single-phase rated short-circuit breaking current of the DCB exceeds the same three-phase rating will be specified in schedule A. The factor offered shall be stated in schedule B.

3.1.10 Transient recovery voltage related to the rated short-circuit breaking current

- a) The first-pole-to-clear factor (k_{pp}) for Disconnecting circuit-breakers used in systems of nominal voltage up to and including 132 kV shall be 1,5 in accordance with SANS 62271-100, i.e. as applicable to Disconnecting circuit-breakers used in non-effectively earthed systems. For Disconnecting circuit-breakers used in systems of nominal voltage above 132 kV, the first-pole-to-clear factor shall be 1,3 in accordance with SANS 62271-100, i.e. as applicable to Disconnecting circuit-breakers used in effectively earthed systems. The first-pole-to-clear factor shall be stated in schedule B.

Note: 44 kV to 132 kV networks are usually solidly earthed. However, in the interests of standardisation, due to the fact that certain 44 kV to 132 kV networks may be non-effectively earthed – a first-pole-to-clear factor of 1,5 is specified.

- b) The standard values of prospective transient recovery voltages given in SANS 62271-100 shall apply according to the DCB class specified in Table 4 for the relevant DCB application and as defined in SANS 62271-100.
- c) The standard values of prospective transient recovery voltages given in SANS 62271-100 shall apply according to the DCB class specified in Table 2 for the 66kV rated DCB application and as defined in SANS 62271-100.
- d) The standard values of prospective initial transient recovery voltages (ITRV) given in SANS 62271-100 shall apply according to the DCB class specified in Table 7 for the DCB rated 100kV and above as defined in SANS 62271-100.

Note: The Disconnecting circuit-breakers shall be capable of withstanding ITRV that, at some network configuration and disturbances, could have a higher Rate of Rise of Recovery Voltage (RRRV) of the SANS 62271-100 Table 7 standard values.

3.1.11 Rated short-circuit making current

The rated short-circuit making current of Disconnecting circuit-breakers shall be equal in value to the rated peak withstand current specified in Table 3. The rated short-circuit making current required will be specified in schedule A. The rated short-circuit making current offered shall be stated in schedule B.

3.1.12 Rated operating sequence

- a) The following rated operating sequence shall apply to all three-pole operated Disconnecting circuit-breakers intended for rapid auto-reclosing. The rated operating sequence required will be specified in schedule A.

Three-phase auto-reclosing: O – t – CO – t' – CO (all poles), where t = 0,3 s and t' = 3 min.

Note: Preference will be given to Disconnecting circuit-breakers offered with a rated operating sequence where t' = 15s, without loss of insulation properties detrimental to the designed disconnecting capabilities.

- b) The following rated operating sequence shall apply to all single-pole operated Disconnecting circuit-breakers intended for rapid auto-reclosing. The rated operating sequence required will be specified in schedule A.

Single-phase auto-reclosing: O (one pole) – t – C (one pole) – O (all poles) – t' – CO (all poles), where t = 0,3 s and t' = 3 min.

Note: Preference will be given to Disconnecting circuit-breakers offered with a rated operating sequence where t' = 15s without loss of insulation properties detrimental to the designed disconnecting capabilities.

- c) The following rated operating sequence shall apply to all Disconnecting circuit-breakers not intended for rapid auto-reclosing. The rated operating sequence required will be specified in schedule A.

O – t – CO – t' – CO (all poles) where t = t' = 3 min.

- d) The rated operating sequence offered shall be stated in schedule B. The minimum resting time (in minutes) required, in order to ensure dependable interruption capability within the Disconnecting circuit-breakers rated characteristics, following the rated operating sequence under the most unfavourable conditions shall be stated in schedule B.

ESKOM COPYRIGHT PROTECTED

- e) All Disconnecting circuit-breakers, irrespective of whether they are intended for rapid auto-reclosing, shall be able to open-close-open before the closing spring needs to be charged again. This shall be without loss of insulation properties detrimental to the designed disconnecting capabilities.

3.1.13 Characteristics for short-line faults

These characteristics are applicable to class S2 Disconnecting circuit-breakers (refer to Table 4) intended for direct connection to overhead lines in systems with a solidly earthed neutral and all Disconnecting circuit-breakers having a rated voltage of 100 kV and above. They are therefore applicable to all Disconnecting circuit-breakers for use in systems of nominal voltage above 66 kV. Refer to 4.105 of SANS 62271-100 for standardised characteristics for short-line faults.

Note 1: 44 kV to 132 kV networks are usually solidly earthed.

Note 2: The Disconnecting circuit-breakers shall be capable of withstanding ITRV that, at some network configuration and disturbances, could have a higher Rate of Rise of Recovery Voltage (RRRV) of the SANS 62271-100 Table 7 standard values.

3.1.14 Rated out-of-phase making and breaking current

The rated out-of-phase breaking current required will be specified in schedule A in accordance with 4.106 of SANS 62271-100. The rated out-of-phase making and breaking currents of the DCB offered shall be stated in schedule B.

The DCB's shall be rated for transient recovery voltage (TRV's) in accordance with the SANS 62271-100 as follows:-

- for Disconnecting circuit-breakers in cable systems with rated voltages less than 100 kV – Table 1;
- for Disconnecting circuit-breakers in line systems with rated voltages less than 100 kV - Table 2;
- for Disconnecting circuit-breakers with rated voltages of 100 kV up to and including 170 kV for effectively earthed systems – Table 3;
- for Disconnecting circuit-breakers with rated voltages of 100 kV up to and including 170 kV for non-effectively earthed systems – Table 4;
- for Disconnecting circuit-breakers with rated voltages 245 kV and above - Table 5,

Note: The Disconnecting circuit-breakers specified for power generator synchronising shall be capable of withstanding the overvoltage and switching transient generated when the system is up to 180 ° out-of-phase condition of across the open contacts at the site conditions which are polluted and wet conditions.

3.1.15 Rated capacitive switching current

- a) The classification of Disconnecting circuit-breakers according to their restrike performance for line- and cable-charging current switching shall be in accordance with Table 4 for the specified DCB application. The DCB class offered for line- and cable-charging current switching shall be stated in schedule B.
- b) The rated line- and cable-charging breaking currents for Disconnecting circuit-breakers shall be in accordance with the preferred values given in SANS 62271-100.
- c) If specified in schedule A, the DCB shall be classified as a class C2 disconnecting circuit-breaker and shall be capable of switching capacitor banks with a very low probability of restrike during capacitive current breaking. In this case, the following requirements are applicable:
- the DCB shall be capable of switching single capacitor banks as well as back-to-back capacitor banks;

- the rated capacitor bank switching currents shall be in accordance with the preferred values given in SANS 62271-100. The DCB class offered, rated capacitor bank switching currents (i.e. the rated single capacitor bank breaking current, the rated back-to-back capacitor bank breaking current and the rated back-to-back capacitor bank inrush making current) and inrush current frequency shall be stated in schedule B; and
- all Disconnecting circuit-breakers supplied for capacitor-bank switching shall be capable of capacitor switching without the need for controlled opening and/or closing.
- shunt capacitor banks will either be connected to a substation busbar or will form part of another device such as a thyristor switched reactive power (VAr) controller (thyristor controlled reactors).

Notes:

- 1) The backup Disconnecting circuit-breakers in the particular substations may not have adequate capacitive switching capabilities. This means that the Disconnecting circuit-breakers intended for shunt capacitor bank switching will have to be relied upon to satisfactorily and reliably (i.e. with a very low probability of restrike) switch the capacitive currents associated with the shunt capacitor banks.
- 2) The shunt capacitor bank DCB will be required to switch more than once a day - in a single and/or back to-back situation of the rating specified - with up to three banks installed on a single substation busbar.
- 3) For the sake of standardisation, preference will be given to general-purpose Disconnecting circuit-breakers offered that are capable of capacitor bank switching duties. However, special-purpose Disconnecting circuit-breakers will be considered.
- 4) Current-limiting reactors will normally be installed by Eskom between the DCB and the shunt capacitor bank being switched in order to obtain transient currents of manageable proportions for the power capacitor elements as well as the DCB.
- 5) The use of controlled switching to provide optimal capacitor-bank switching is recommended. Refer to 3.2.18.

3.1.16 Inductive load switching

The Disconnecting circuit-breakers for reactor switching applications shall be capable of switching shunt reactors and line reactors and shall be designed to withstand re-ignitions due to TRV's. They shall be type tested to SANS 62271-110 (applicable only to three-phase alternating current Disconnecting circuit-breakers having rated voltages of 52 kV and above). The chopping number of the DCB offered shall be stated in schedule B.

Notes:

- 1) The maximum ratings of existing (earthed) shunt reactors are typically 40 MVar to 50 MVar at 132 kV, 100 MVar at 400 kV and 400 MVar at 765 kV (i.e. 133 MVar per phase).
- 2) The use of controlled switching to provide re-ignition-free shunt reactor switching is recommended. Refer to 3.2.18. In the absence of controlled switching, re-ignitions during opening of the contacts cannot be avoided due to the random operation (opening) of the DCB. By means of controlled opening, all poles of the shunt reactor DCB can be given a sufficiently long arcing time to ensure re-ignition-free interruption. The use of controlled switching will minimise high magnitude fast-fronted (steep) switching transients created during re-ignition events and will prolong the maintenance intervals of the DCB.
- 3) Information obtained from tests conducted in accordance with SANS 62271-110, i.e. the DCB chopping number (used to determine the suppression peak overvoltage factor) and the re-ignition behaviour, can be used to correctly configure the controller.

The type test record proof of inductive load switching capability of the DCB shall be provided with the tender documentation.

3.1.17 Rated time quantities

The rated opening time, break-time, closing time, open-close time, reclosing time, close-open time and pre-insertion time (where applicable) of the DCB offered shall in accordance with SANS 62271-108 and SANS 62271-100. It shall be stated in schedule B.

3.1.18 Number of mechanical operations

The number of mechanical operations of Disconnecting circuit-breakers shall be in accordance with the mechanical endurance class specified in Table 4 for the specified DCB application and as defined in SANS 62271-100. The DCB class offered shall be stated in schedule B.

3.1.19 Classification of Disconnecting circuit-breakers as a function of electrical and mechanical endurance

The classification of Disconnecting circuit-breakers as a function of electrical and mechanical endurance shall be in accordance with SANS 62271-100. The extended electrical endurance class shall be in accordance with the SANS 62271-310 for the specified DCB for use on overhead lines. The DCB class offered shall be stated in schedule B.

Table 4: Classification of Disconnecting circuit-breakers (SANS 62271-100)

DCB	DCB application	DCB class	Electrical endurance	Re-strike performance during capacitive current breaking (line- and cable-charging)	Mechanical endurance
66 kV, 2500 A, 31,5 kA	As per Technical A/B Schedule	S2 ¹⁾	E2	C2	M2
66 kV, 3150 A, 31,5 kA	As per Technical A/B Schedule	S2 ¹⁾	E2	C2	M2
88 kV, 2500 A, 31,5 kA	As per Technical A/B Schedule	S2 ¹⁾	E2 ²⁾	C2	M2
132 kV, 2500 A, 31,5 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
132 kV, 3150 A, 40 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
170 kV, 3150 A, 40 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
220 kV, 3150 A, 40 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
275 kV, 3150 A, 50 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
275 kV, 4000 A, 50 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
400 kV, 3150 A, 50 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
400 kV, 3150 A, 63 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
400 kV, 4000 A, 50 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
400 kV, 4000 A, 63 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
550 kV, 4000 A, 63 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2	M2
765 kV, 3150 A, 50 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2 ³⁾	M2
765 kV, 4000 A, 50 kA	As per Technical A/B Schedule	N/A	E2 ²⁾	C2 ³⁾	M2
+/- 533kV DC ³⁾	As per Technical A/B Schedule	N/A	E2 ²⁾	C2 ⁴⁾	M2

Notes:

- 1) Class S2 Disconnecting circuit-breakers (i.e. Disconnecting circuit-breakers intended to be used in line systems) are restricted to systems of rated voltages equal to or higher than 15 kV and less than 100 kV – in accordance with SANS 62271-100. Class S2 Disconnecting circuit-breakers are specified due to the fact that they may be used in systems with direct connection to overhead lines / outdoor busbars without intervening cables. In the case where Disconnecting circuit-breakers are used in cable systems, class S2 Disconnecting circuit-breakers are suitable.
- 2) The DCB with the extended electrical endurance class E2 and extended mechanical endurance class M2 shall be preferred for minimal maintenance purpose.
- 3) Cable-charging breaking current switching duties are not applicable to 765 kV Disconnecting circuit-breakers.
- 4) For +/- 533kV HVDC scheme application, the current shall be 1800A DC. It shall be demonstrated if the DCB does have the capability of carrying up to 3300A for the system emergencies and future requirements.

ESKOM COPYRIGHT PROTECTED

3.2 Design and construction

The DCB design shall be in accordance with SANS 62271-108 clause 5, and take into account the mechanical, electrical and other requirements of a circuit-breaker and a disconnector as a single device. Where the earthing switch is integral to the DCB, it shall be compliant to this standard and the Eskom's, 240-56063815, High Voltage Outdoor Disconnectors and earthing switches standard and the standard for disconnectors.

3.2.1 Service conditions

- a) The normal service conditions for outdoor switchgear and controlgear specified in SANS 62271-1 shall apply. The following additional specific requirements shall be taken into account:
- 1) a minimum ambient air temperature of -10 °C;
 - 2) a maximum ambient air temperature of +45 °C (refer to 3.1.4 e));
 - 3) rapid temperature changes. The condensation of water vapour can take place within operating mechanism enclosures and hollow components. The average humidity is 95 %;
 - 4) wind velocity of 34 m/s (N);
 - 5) solar radiation up to a level of 1 100 W/m² (on a clear day at noon);
 - 6) the DCB shall be installed up to altitudes of 1 800 m;
 - 7) the ice coating shall be considered in the range from 1 mm up to, but not exceeding, 20 mm;

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

- the class of pollution characterising the site severity will be specified in schedule A in accordance with SANS 60815-1:2009 (e.g. class "e" corresponding to "very heavy"); and
- The class of corrosion characterizing the site severity will be specified in Schedule A in accordance and the details required under clause [3.2.6](#) shall be supplied with tender documentation.
- seismic activity up to 0,3g.
- Disconnecting circuit-breakers for use in systems of nominal voltage up to and including 132 kV shall be suitable for operation in systems that incorporate a non-effectively earthed neutral. Disconnecting circuit-breakers for use in systems of nominal voltage above 132 kV shall be suitable for operation in systems that incorporate an effectively earthed neutral.

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

3.2.2 General

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

- Response to the Digital secondary plant interface option clauses 3.2.19.1 and 3.21.1 and Annex C.
- Provide the detailed Factory Failure Rate (FFR) percentage over the period of 5 years.
- Provide information on On Time Delivery (OTD) percentage over the period of 5 years.
- Provide technical response to Non-Conformance (NCR's) percentage over a period of 1 year.
- Full maintenance analysis FMECA of the DCB unit as per Annex D.

Note: The DCB with the extended electrical endurance class E2 and extended mechanical endurance class M2 shall be preferred for minimal maintenance purpose.

3.2.2.1 The following are the requirements for the Disconnecting circuit-breakers:-

- a) Outdoor Disconnecting circuit-breakers shall comply with the requirements of SANS 62271-108 and the requirements of this standard. In case of the dead-tank Disconnecting circuit-breakers, it shall also comply with the requirements of SANS 62271-203 and its outdoor bushings to [1] SANS 60137. Where conflicting requirements exist, the requirements of this standard shall take precedence.
- b) Disconnecting circuit-breakers shall be of the live-tank or dead-tank design. The type of design required will be specified in schedule A. The type of design offered shall be stated in schedule B.
- c) Dead-tank Disconnecting circuit-breakers shall be supplied with integrated ring-type current transformers (CTs). CTs shall be located at the base of the outdoor bushings.

The compartment/ tank metallic enclosure shall be made of aluminium or aluminium alloys for all standard Eskom requirements, unless the requirement is for coastal application, a different specification metal shall be indicated on the Technical A schedule. Other metals for compartment/ tank metallic enclosures with their corrosion treatment method in accordance with clause 3.2.6 shall be submitted with the tender documentation and will be subject to approval by Eskom.

- d) Disconnecting circuit-breakers shall be supplied complete with all the necessary components for the assembly. Live-tank Disconnecting circuit-breakers for use in systems of nominal voltage up to and including 132 kV shall be supplied suitable for a pole-beam support arrangement (two-column support with common base frame). This shall be applicable to Disconnecting circuit-breakers with the in-built earthing switch. Live-tank Disconnecting circuit-breakers for use in systems of nominal voltage from above 132 kV up to and including 400 kV shall be supplied suitable for a three-column support arrangement. It will be specified in schedule A whether Disconnecting circuit-breakers shall be supplied with the steel support structure.

Notes:

- 1) For further information relating to the Supplier's and Eskom's scope of responsibility, refer to Annex A.
- 2) For live-tank Disconnecting circuit-breakers for use in systems of nominal voltage up to and including 132 kV, the steel common base frame is supplied with the DCB (refer to c)). The Disconnecting circuit-breakers are supplied without the steel support structure columns (legs). Refer to Table 5 for further information on the standard Eskom support structure drawings.
- e) DCB operating mechanisms:
 - Disconnecting circuit-breakers shall be either three-pole ("3P") operated (i.e. single operating mechanism) or single-pole ("1P") operated (i.e. three operating mechanism), as specified in schedule A.
 - Disconnecting circuit-breakers shall be designed for stored energy operation where energy is stored in a spring, unless otherwise approved by Eskom. The spring-hydraulic operated mechanisms shall be considered for Dead-tank Disconnecting circuit-breakers with the rated voltages of above 145 kV. The spring-hydraulic operated mechanisms may be accepted for use in the Live-tank Disconnecting circuit-breakers with the rated voltages of 550 kV and 800 kV.

Note: Other hydraulic operated or pneumatic operated mechanisms will not be accepted for all voltages.

- 1) It shall be possible to charge the DCB operating mechanism spring both manually and electrically. Electrical charging shall be via a spring charging motor, unless otherwise approved by Eskom. Both manual and electric energy release shall be provided. The mechanical energy stored in the charged spring shall be stated in schedule B. A mechanical device shall be provided to prevent over-charging of the closing spring when the manual charging facility is employed.
- 2) Operating mechanisms shall be designed in such a way that in the case of failure to latch or of a command to trip during a closing operation, safe conditions are produced for the elements controlling the DCB.
- 3) When a feeder DCB is in the closed position and the spring has been charged, it shall be able to "TRIP-CLOSE-TRIP" before the spring needs to be recharged

ESKOM COPYRIGHT PROTECTED

- f) The insulation and/or extinguishing medium of the DCB shall be either SF6 gas or environmental friendly medium. The type of interrupting and insulation and/or extinguishing medium technology offered shall be stated in schedule B. For SF6 gas Disconnecting circuit-breakers, the type of interrupter design (e.g. puffer, self-blast, etc.) as well as the configuration of the moving contacts (e.g. single, double or triple motion design) shall be stated in schedule B.

Note: The DCB designs that offer environmental friendliness and meet this standard shall be considered. These shall have been designed and type tested in accordance with IEC62271-100.

- g) Disconnecting circuit-breakers shall be designed for minimal maintenance in accordance with the electrical and mechanical endurance class as specified in Table 4.

Note: In line with minimal maintenance, the DCB designs that offer the extended electrical endurance Class E2 and extended mechanical class M2 shall be preferred.

The minimum expected lifespan shall be 40 years. Premature failures experienced in service of similar design Disconnecting circuit-breakers supplied elsewhere by the manufacturer shall be made known to Eskom, together with the recommended modifications. This information shall be provided with the tender documentation (refer to 3.2.23.1).

- h) Dead-tank Disconnecting circuit-breakers detailed information on how CT's are accessed for primary injection testing and CT replacement, without having to interfere with the SF6 circuit shall be provided with the tender documentation.

3.2.2.2 Interlocking device requirement

The DCB shall be fulfil the requirements of the OHS ACT [26] and ORHVS [38] for ensuring safety when it is in the isolating distance position and, where applicable, the earthed position. The details of this method shall be submitted with tender documentation, demonstrated upon Eskom factory visit and subject to Eskom approval.

It shall be demonstrated that the DCB design has the safe operation as a disconnector in open position and where applicable, when specified with the earthing switch that it uses a dependable interlocking device that cannot malfunction when applied.

- a) The interlocking device shall be in accordance with SANS 62271-108 clause 5.11.
- b) When the earthing switch is specified, the DCB mechanical interlocking device shall be designed in compliance to SANS 62271-108 clause 5.11.
- c) The interlocking device for the disconnector position shall not be compromised by the type of the mechanical operating mechanism.

3.2.2.3 Integral earthing switch requirement

Where the earthing switch is integral to the DCB, it shall be compliant to this standard and the Eskom's, 240-56063815, High Voltage Outdoor Disconnectors and earthing switches standard and the standard for disconnectors.

-
- a) The earthing switch rated voltage, current, short-time withstand current, making current and insulation shall, unless otherwise specified, be at least equal to that assigned to the disconnector part of the DCB.
 - b) The earthing switch class shall be E1 as a minimum. The type tests proof shall be submitted with tender documentation.
 - c) The earthing switch shall be of motorised operation and manual hand operation, in accordance with Eskom requirement.
 - d) The earthing switch operating mechanism enclosure shall be capable of being padlocked to prevent unauthorized access. The locking facility shall accommodate padlocks that have a shackle diameter of 6 mm. The padlocking facility details shall be submitted with the tender documentation for Eskom approval.

3.2.2.4 The maintenance outage disconnecting device requirement

The DCB shall be offered with the maintenance outage disconnecting device facility which shall be used for maintenance outage purpose. This device shall be in accordance with the OHS ACT [26] and ORHVS [38]. It shall have been type tested accordingly and all the details, including the operating instructions, shall be submitted with the tender documentation for Eskom approval.

- a) The maintenance outage disconnecting device shall ensure safe working procedure.
- b) The maintenance outage disconnecting device facility shall be with minimal complexity to operate by normal operating personnel, who should operate it without leaving ground level.
- c) The device shall be of a reliable design and operation. It shall not result in loose connection of the DCB and its associated parts leading to the development of a hot connection.
- d) The device shall be suitable for use with a mechanical support that is insulated from ground, and cannot be damaged due to the use of its operating tools by personnel operating it from ground level.
- e) The device special tools list shall be submitted with tender documentation. The details of the device with its special tools list shall also be found on the DCB instruction manual package.

3.2.3 Construction requirements

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

- a) the various elements of the DCB shall be standardised. Standardisation of parts shall be pursued;
- b) modular, pre-assembled elements shall be designed to facilitate handling and installation;
- c) the equipment shall be designed to facilitate construction and maintenance activities for personnel; and
- d) SF6 filter material housing shall be located (at the DCB pole) in such a manner so as to provide easy access when maintaining the unit.

3.2.4 DCB operating mechanism enclosure requirements

- a) DCB operating mechanisms, local control facilities and all parts requiring lubrication shall be protected by weatherproof enclosures. The degree of protection provided by these enclosures shall comply with the following minimum requirements in accordance with SANS 60529. The degree of protection offered shall be stated in schedule B.
 - enclosures containing exposed bearings, auxiliary switches, motors and other electrical devices shall comply with IP 55 (i.e. operating mechanism enclosure);

-
- where applicable, all open areas in the DCB common base frame as well as externally mounted indicating devices where there is a high probability of birds nesting, shall be suitably covered to IP 2X; and
 - all other enclosures provided shall comply with IP 54.
- b) The operating mechanism enclosure, handles and fixings shall be manufactured from 3CR12 stainless steel with corrosion protection in accordance with 3.2.6. The use of factory painted aluminium shall be considered if corrosion protection is in accordance with 3.2.6, and no parts exposed. The mechanism enclosures of the exposed aluminium shall not be acceptable.
- c) Operating mechanism enclosures shall be arranged to facilitate easy access for inspection and scheduled maintenance which may include permissible in-situ cleaning, lubrication, repairs and adjustments to the operating mechanism. Any removable covers provided shall have bolt fastenings, subject to Eskom approval. All bolts shall be inherently corrosion resistant and have hexagon heads. Self-tapping screws, captive head nuts or cage nuts are not acceptable.
- d) The DCB shall be designed for operation from the front of the operating mechanism enclosure.
- e) Access to the operating mechanism enclosure(s) shall be through a hinged access door allowing accessibility to components installed in the enclosure (e.g. control levers, push-buttons, MCBs and secondary wiring terminal strips) in accordance with SANS 62271-1.
- f) In the case of Disconnecting circuit-breakers for use in systems of nominal voltage up to and including 132 kV, servicing shall be possible from the ground level. In the case of Disconnecting circuit-breakers for use in systems of nominal voltage above 132 kV, where the servicing level may be above ground level, it shall be possible to view all DCB status indications and make necessary readings from the ground level. Details of special equipment required (including inspection platforms) to fulfil this requirement shall be provided with the tender documentation (refer to 3.2.23.1).
- g) The front access door shall be secured with a heavy-duty locking mechanism.
- h) The operating mechanism enclosure shall be capable of being padlocked to prevent unauthorized access. The locking facility shall accommodate padlocks that have a shackle diameter of 6 mm.
- i) The front access door of the operating mechanism enclosure shall be equipped with a travel stop, which shall retain the door in the open position. The facility shall be robust enough to withstand the force of wind in accordance with 3.2.1.
- j) A rigid, corrosion resistant, documentation pocket shall be provided for the safe-keeping of all relevant documentation (i.e. the installation, operating and maintenance instructions for the DCB and all routine test certification), on the inside of the operating mechanism enclosure front access door. The documentation pocket shall be securely attached and the means used (e.g. pop rivets) to secure the pocket shall not protrude through the door.
- k) Suitable facilities for storage and securing of the hand-operating tool(s) shall be provided on the inside of the operating mechanism enclosure front access door.
- l) Earthing of the operating mechanism enclosure shall be via the steel support structure (e.g. via the common base frame and support legs or via the steel column support). If additional / visual earthing is required for the operating mechanism enclosure, all earthing terminals, fastenings and conductors shall be supplied and fitted by the Supplier and will be subject to approval by Eskom. In the latter case, the conductors shall be kept as short as possible and the earthing terminal on the operating mechanism enclosure shall be located towards the top of the enclosure housing. Earthing conductors shall be manufactured using galvanised steel. A 30 mm long, Ø25 mm (min) metallic boss, with an M12 thread throughout and welded to the equipment shall be used for all external earthing conductor fastenings. The boss shall be fitted with a M12 x 25 mm long setscrew, washer and spring washer. The boss and the setscrew on the enclosure shall be stainless steel of grades 304 and 316, respectively, unless otherwise approved by Eskom. The boss and the setscrew on the DCB steel support structure (e.g. the common base frame or the steel column support) shall be galvanised steel.

Note: The use of copper or aluminium is considered to present a theft risk and will not be accepted if metal is visually exposed. Such method shall meet clause 3.2.6. The proposal to prevent visual exposure shall be presented to Eskom for approval with the tender documentation.

- m) Operating mechanism enclosures shall make provision for the entry of Eskom control cabling from below. Refer to c) for the requirements of the control cable entry gland plates. All DCB cabling (i.e. to / from density monitoring devices and between poles) shall also enter the operating mechanism enclosure(s) from below, unless otherwise approved by Eskom.

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

- n) Where applicable, metallic cable racking used to mechanically protect and/or support DCB 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.
- 3) The use of plastic material cable ties shall not be accepted.
- o) Upper surfaces of enclosures shall be shaped or sloped to prevent the accumulation of water.
- p) Gaskets shall be made of neoprene rubber, nitrile rubber or cork, unless otherwise approved by Eskom. Felt or natural rubber gaskets are not acceptable. The gasket material offered shall be stated in schedule B.
- q) A gauze-covered drain hole with a minimum diameter of 25 mm and having no internal rim or ledge that is likely to obstruct drainage shall be provided at the lowest point of the operating mechanism enclosure.
- r) Suitable lifting eyes shall be provided at the top of the operating mechanism enclosure. The lifting eyes shall be designed to provide for the lifting of the complete operating mechanism enclosure. Lifting eyes with a minimum diameter of 30 mm shall be provided.
- s) The colour for the enclosure shall be "light grey" (G29) in accordance with SANS 1091 unless otherwise specified in schedule A or approved by Eskom.
- t) All Disconnecting circuit-breakers shall be fitted with a mechanical trip facility which does not require any voltage to operate and must be located inside the mechanism enclosure. It shall be clearly marked with warning labels.

3.2.5 Rated static terminal load and dynamic forces on DCB and its support structure and foundation

The rated static terminal loads shall be in accordance with SANS 62271-108 clause 4.112. Ice coating and wind pressure on the DCB shall be in accordance with 2.1.2 of SANS 62271-1.

- a) The following mechanical loads and parameters relating to the design of the DCB support structure and foundation shall be stated in schedule B and be shown on the general arrangement drawing (refer to 3.2.23.1):
- "static" dead weight of the DCB (N);
 - the rated "static" terminal forces F_{thA} , F_{thB} and F_{tv} of the DCB (N) due to connected conductors;
 - the rated "static" terminal load (resultant forces) F_{shA} , F_{shB} and F_{sv} (loads) of the DCB (N) due to connected conductors;

Note: Static terminal loads (forces) due to flexible and tubular conductors (not including wind, ice load or the dynamic loads on the DCB itself) can be assumed to be in accordance with Table 1 of SANS 62271-108.

ESKOM COPYRIGHT PROTECTED

-
- "dynamic" horizontal force (load) exerted during operation on the foundation (N);
 - "dynamic" vertical force (load) exerted during operation on the foundation (N);
 - "dynamic" moment (torque) exerted during operation about the foundation (Nm);
 - "dynamic" horizontal force exerted between DCB poles (centre phase interrupter chamber) during a rated (terminal fault) short-circuit (N);
 - wind force (load) exerted on the DCB due to a wind velocity of 34 m/s (N);
 - maximum torque required for the foundation holding down bolt nuts used to secure the support structure column to foundation (Nm);
 - mounting and fastening arrangement for the DCB support structure onto the foundation including the minimum required length of foundation holding down bolts; and
 - centre of gravity of the DCB.
- b) If specified in schedule A, the steel support structure and/or concrete foundation shall be designed by the manufacturer. If the manufacturer's DCB design requirement and steel support structure cannot be met by Eskom standard drawing provided in Table 5, the Supplier shall provide with the tender documentation details of the steel support structure and requirement for the concrete foundation. A drawing showing the steel support structure and concrete foundation design details shall be provided with the tender documentation (refer to 3.2.23.1) and the drawing number(s) shall be stated in schedule B.
- The steel support shall be designed according to the following requirements (if part of the supply):
- Steel shall be in accordance with SANS 1431
 - Steel shall be Grade 350W.
 - Steel shall be hot-dip galvanised in accordance with SANS 121.
 - Welding shall conform to the requirements of SANS 10044.
 - Welds shall be seal welded.
 - Steelwork shall be fabricated, erected and leveled to a tolerance of $\pm 1.5\text{mm}$.
 - Bolts and nuts shall be in accordance with SANS 1700:5.
 - Bolts and nuts shall be Grade 8.8.
 - Bolts, nuts and washers shall be hot-dip galvanised in accordance with SANS 121 and SANS 10684.
 - Holes shall have diameter of 18mm for M16 bolts.
 - All works shall comply with the requirements of SANS 1200
- c) In the case of live-tank Disconnecting DCBs for use in systems of nominal voltage up to and including 132 kV, the DCB common base frame (i.e. for a pole-beam support arrangement) shall be supplied with the DCB and designed to interface with the standard Eskom steel support structure and concrete foundation in accordance with the drawings specified in Table 5.
- d) Unless it is specified in schedule A that the steel support structure and/or concrete foundation is to be designed by the manufacturer, the DCB shall be designed to interface with the standard Eskom steel support structure and/or concrete foundation in accordance with the drawings specified in Table 5. Unless the Supplier has established that the DCB design and steel support structure requirement cannot be met by the Eskom standard drawing specified in Table 5, then details shall be provided as per b) above.

Table 5: Eskom standard civil design drawings for outdoor live-tank circuit-breaker steel support structures and concrete foundations

System voltage [kV]	Steel support structure drawing number (live-tank circuit- breakers)	Concrete foundation drawing number (live-tank circuit- breakers)
66	D-DT-5201-2	D-DT-5201
88 and 132	D-DT-5200-2	D-DT-5200-1
220 and 275	0.54/7479-0-0	0.54/7471-0-0
400	0.54/7479-0-0	0.54/7472-0-0
765	TBA ¹⁾	TBA ¹⁾
+/- 533 DC	TBA ¹⁾	TBA ¹⁾

Notes:

- 1) Standardised drawings are not (yet) available.
- 2) These drawings shall be applicable to equipment with the higher rated voltages
- 3) Where Eskom specifies a DCB with the integral earthing switch, e.g. on the single interrupter unit designs (candle-stick), the above Eskom standard drawing shall be evaluated by the Supplier if they shall be technically suitable for the mechanical loading of the design. The Supplier shall submit the proposed design of the steel support and foundation drawings with the Tender documentation.
- 4) Where the Supplier establishes the DCB design and steel support structure cannot be met by the above Eskom standard drawings, the Supplier shall submit the details of the steel support structure and foundation drawings with the Tender documentation.

3.2.6 Corrosion protection and lubrication

- 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. marine) corrosivity 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 will be not accepted.

- c) 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. Details shall be provided with the tender documentation (refer to 3.2.23.1):
 - enclosures;
 - nuts, bolts, studs and washers;
 - structural steel (i.e. common base frame, support structure legs, etc.); and
 - other exposed metal (excluding main terminals).
 - The detailed material and Corrosion Protection Information in accordance with the Table 6 below shall be provided by the Supplier with the tender documentation the information on each supplied live-tank DCB and dead-tank DCB type as specified below:-

Table 6: Material and Corrosion Protection Information

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

ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **30 of 107**

Material grade		(BS 970 080M40)
Type of corrosion protection		HD galvanising
Minimum thickness of protective coating		85 micro
Material and Corrosion Protection Information		
Eskom specified requirements	To be completed by Supplier	Completed Example
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 Zincfix
Bi-metallic corrosion prevention		Coat both sides
Crevice corrosion prevention		Seal with crevice with Zincfix
Item or part weight in Kilogram		7kg
Field experience		Equipment used at coastin USA
Remarks/General comments		Debris, scratches and indentation have been removed prior to galvanising.

- d) The behavior of lubricants that are exposed to air, SF6 gas and its arcing products shall be stable over the intervals between maintenance. The Supplier is required to identify the lubricants used and to submit details with the tender documentation (refer to 3.2.23.1) of tests carried out to prove suitability for the application. If possible, a list of equivalent lubricants from South African sources shall be provided. All liquids or chemicals shall be supplied with Material Safety Data Sheets (MSDS).
- e) For all DCB types, the Supplier shall give details with the tender documentation (refer to 3.2.23.1) of the measures taken to prevent flange corrosion. These details shall include drawings of the flange arrangements, treatments, maintenance frequency and service experience.

f) Material and Corrosion Protection Information

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

DCB operating mechanism enclosure heaters

- 1) Suitably rated electric heater(s) shall be installed to prevent moisture condensation inside the DCB operating mechanism enclosure. The heater size offered shall be stated in schedule B.
- 2) Heaters shall maintain a dew-point greater than the ambient temperature and shall circulate the air constantly to all parts of the enclosure.
- 3) The electrical supply for heaters shall be single-phase 230 V a.c.
- 4) Heater control and alarm circuits shall comply with the requirements of 240-56030489. In the case of Disconnecting circuit-breakers for use in systems of nominal voltage up to and including 132 kV, heater fail alarm circuits shall be wired to terminals in accordance with D-DT-5407. In the case of Disconnecting circuit-breakers for use in systems of nominal voltage above 132 kV, heater fail alarm circuits shall be wired to terminals in accordance with 0.54/07529 and 0.54/8557.

ESKOM COPYRIGHT PROTECTED

3.2.7 Terminal requirements

a) Main (HV) terminals

- 1) The type of DCB main terminals required will be specified in schedule A. Unless otherwise specified in schedule A, the DCB main terminals shall be in accordance with SANS 62271-301 and specifically;
- 2) 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. The diameter of the holes shall be 14 mm (M12).

Note: For the 220 kV and above Disconnecting circuit-breakers, an 9 hole aluminium flat pad with a 40 mm pitch having a minimum thickness of 20mm shall be acceptable. The diameter of the holes shall be 14 mm (M12).

- 3) The arrangement of the HV main terminals shall be such that they can be removed without interfering with the integrity of the DCB.

b) Earthing terminals

Note: Earthing of the DCB to the main substation earth grid is achieved through the support structure and the foundation holding down bolts, unless otherwise specified or approved by Eskom.

- 1) If the continuity between the DCB and support structure is not achieved, then a suitably rated conductor (preferably not exposed copper and aluminium) shall be provided between the DCB and the support structure.
- 2) In the case where the steel support structure is supplied with the DCB, an additional M16 (Ø18 mm hole) hole shall be provided in the steel support structure approximately 100 mm above the base of the support structure (i.e. above the concrete foundation) for the connection of external earthing conductors.

Details of the DCB HV main terminals and earthing shall be provided on the general arrangement drawings as described in 3.2.23.1.

3.2.8 Safety clearances and personnel safety

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

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

- b) The electrical clearance from ground to live parts at system voltage, which based on the minimum safety clearances as required by statutory requirements contained in the Occupational Health and Safety Act No. 85 of 1993, shall be complied with. Electrical working clearances are given in Table 7.

Table 7: Minimum electrical working clearances

System voltage (kV]	Working clearance (mm]
44 and 66	3 270
88 and 132	3 950
220	4 350
275	4 850
400	5 700
765	8 000
+/- 533 DC	Supplier to comply as per note

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

-
- c) The distance from ground level to the base of any high-voltage (i.e. > 1000 V) insulation shall not be less than 2 500 mm.
 - d) Pressure relief devices shall be orientated so as not to pose any hazard to personnel or adjacent equipment. Details of pressure relief devices offered shall be provided with the tender documentation.
 - e) In the case of dead-tank Disconnecting circuit-breakers, the requirements for internal faults (internal arc) and pressure relief devices shall be in accordance with SANS 62271-203. The Supplier shall provide details with the tender documentation (refer to 3.2.23.1) regarding the time during which an arc due to an internal fault up to a given value of short-circuit current will cause no external effects. The definition of this time shall be based on test results or an acknowledged calculation procedure. Refer to clause D.1 of SANS 62271- 203. The duration of current without burn-through for different values of the short-circuit current may be estimated from an acknowledged calculation procedure.
 - f) For integral type earthing switch fitted to a DCB 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.

3.2.8.1 Securing of position requirement

The DCB shall be fulfil the requirements of the OHS ACT [26] and ORHVS [38] for ensuring safety when it is in the isolating distance position and, where applicable, the earthed position. The method for securing of position shall be submitted with tender documentation, demonstrated upon Eskom factory visit and subject to Eskom approval.

Personnel without leaving ground level shall be able to visually see and know the operating position of the DCB. The DCB shall have a reliable position indicating device which shows the position of each movable that ensures the isolating distance.

For the safety of personnel, the DCB shall have the mechanical locking device when in open position and disconnecter position. This shall also apply when it has the integral earthing switch.

The DCB shall be designed in such a way that it cannot come out of its position by any mechanical force or accidental touching of the operating system or its mechanical structure. When the DCB is locked in the open position serving its disconnecter functionality, it shall not be possible that the DCB would close in any circumstance.

- a) It shall be possible to mechanically lock the DCB in its open position by a reliable mechanical blocking of the DCB power kinematic chain.
- b) It shall be possible to electrically control the mechanical blocking device remotely. When the blocking system is activated, electrical operation shall be prevented by disconnecting all closing circuits.
- c) It shall, furthermore, be possible to mechanically operate the blocking device locally. The motor circuit, or its equivalent, shall be automatically disconnected before local operation is made possible.
- d) The blocked position shall be clearly indicated and visible from outside the control cubicle, in accordance to labels requirements, refer to clause 3.2.11.
- e) It shall be possible to lock the mechanical blocking device when in the open disconnecter position with a padlock according to the Eskom's standard in compliance to the ORHVS [38].
- f) In the case of the DCB that uses there separate operating mechanisms, the interlocking device shall ensure that all poles are locked in the open position. There shall be the master operating mechanism that will ensure this open position.

3.2.9 Insulation requirements

- a) Hollow insulators

-
- The insulator material shall be ceramic or of the silicone rubber composite type. However, silicone rubber composite type insulators shall be preferred. If applicable, the material type will be specified in schedule A. The type of insulator material offered and manufacturer shall be stated in schedule B.
 - Insulators of the ceramic type shall be in accordance with the requirements of SANS 62155 and SANS 60815-2.
 - Insulators of the silicone rubber composite type shall be in accordance with the requirements of SANS 61462 and SANS 60815-3.
 - Only for items in which it is requested in the technical schedules, KIPTS (Koeberg Insulation Pollution Test Site) certificates must be supplied for Medium ("c"), Heavy ("d") to Very heavy ("e") site pollution severity (SPS). The KIPTS test facility limitation is currently (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.
 - $U_n > 132\text{kV}$: For insulators for applications with nominal voltages greater than 132kV (i.e. lightning impulse withstand greater than 550kV), the results from the test on 132kV insulator will be extrapolated to longer insulators having the same design in addition to performing the IEC 60507 artificial pollution test.
- b) Minimum creepage distances
- The minimum unified specific creepage distance (USCD) required in accordance with SANS 60815-1 for external insulation shall be as specified in schedule A. The unified specific creepage distance (USCD) for external insulation has been rationalised to:-
 - 34,7 mm/kV for "c - medium" site pollution severity (SPS) class;
 - 43,3 mm/kV for "d - heavy" site pollution severity (SPS) class; and
 - 53,7 mm/kV for "e - very heavy" site pollution severity (SPS) class.

Table 8: Minimum creepage distances (USCD and SCD) and the SPS class

Site Pollution Severity class	USCD (mm/kV)	SCD (mm/kV)
"c – medium"	34,7	20
"d – heavy"	43,3	25
"e – very heavy"	53,7	31

- The actual creepage distance offered shall be stated in schedule B.

Clearances in air

- Eskom reserves the right to call for clearances greater than those already successfully proven by dielectric tests.
- c) The phase-to-phase clearance, measured by the taut string method. Phase-to-phase and phase-to-earth clearances, measured by the taut-string method, shall be stated in schedule B.

3.2.10 Position indication (status indication)

The DCB shall be in compliance with SAN 62271-108 clause 5.12.

- a) The DCB main contact position indication shall be clearly visible from ground level and from outside the DCB operating mechanism enclosure when the front access door is closed.
- b) The following symbols and colours shall be used for the position indication of the DCB main contacts:
 - DCB closed: "I" in white lettering on a red background
 - DCB open: "O" in white lettering on a green background
- c) Lettering size shall be at least 30 mm, unless otherwise approved by Eskom.
- d) The closing-spring condition (i.e. charged or discharged) shall be indicated by a mechanical device. It shall be clearly visible from outside the DCB operating mechanism enclosure when the front access door is closed. The words "SPRING CHARGED" and "SPRING DISCHARGED" shall be displayed in black lettering on a white background. The lettering height shall be at least 15 mm. The use of symbols to indicate spring condition will not be accepted.
- e) Each DCB shall be provided with an operation counter that is advanced each time the DCB main contacts open or alternatively each time the main contacts close (i.e. not both). Mechanical operation counters are preferred, but electrical counters are also acceptable. The DCB operation counter shall be non-resettable. The counter shall have, at least, a capability of counting up to 99 999 operations. The operation counter shall be connected prior to routine testing to reflect all factory and pre-commissioning operations. The type of operation counter shall be stated in schedule B. The Supplier shall submit full details of the operation counter on request by Eskom.
- f) In the case of SF6 Disconnecting circuit-breakers, pressure gauges (compensated for temperature and responding to SF6 gas density) shall be provided. These devices shall be sheltered from the elements to ensure that the reading provided is correct and to prevent ageing of the device, and this requirement shall apply to all DCB types with other insulation and/or extinguishing medium.
- g) All indicating devices shall be clearly visible and legible by persons with normal vision standing at ground level. In addition, it shall be possible to carry out all routine inspection activities from the ground level.

3.2.11 Labels

- a) Operating labels associated with local operation of the DCB shall be securely attached to the inside of the operating mechanism enclosure front access door and be as follows (black text on white background, in English):
- Instructions for tripping and closing the DCB: These instructions shall be titled "TO TRIP" DCB and "TO CLOSE" DCB, respectively. Additional information required to perform these functions shall be referred to Eskom;
 - Instruction for OPEN disconnecter position and BLOCKED operation of the DCB: These instructions shall be titled "BLOCKED" DCB; and
 - Instructions for charging the closing spring: The instruction shall be titled "TO CHARGE SPRING" and located near the actuator for local mechanical spring charging.
- b) The actuator(s) for local opening and closing of the DCB shall be identifiable by all three of the following methods:
- by labelling, in English, printed with black text on a white background reading "TRIP" and "CLOSE", respectively. The symbols "O" and "I" may be used as additional means to identify the respective trip and close controls;
 - by actuating direction or position. A rotary switch shall be turned anti-clockwise to trip the circuit- breaker and clockwise to close the DCB. Trip and close push buttons shall be oriented vertically or horizontally and shall have the trip button at the bottom or to the left of the close button [IEC 60447]; and
 - by colour coding. The colour green shall be associated with the trip control and red with the close control. Alternatively the controls shall be without unique colour.

Note: The Eskom colour coding convention for trip/close actuators is opposite to that specified in IEC 60073 (i.e. IEC requires trip red and close green).

- c) An appropriate warning label shall be displayed to draw attention to the danger of performing manual operations without an adequate amount of insulation and/or extinguishing medium inside of the DCB.

Note: The warning label for the mechanical trip facility shall be displayed.

- d) A warning label shall be displayed within the operating mechanism enclosure to draw attention to the minimum time interval required between repeated CO operations during testing.
- e) All relays, instruments, fuses, MCBs, control switches, luminous indicators and links, the functions of which are not clearly identified by signs or pictograms, shall be clearly labelled to indicate their functions. These labels shall be in text using black letters at least 5 mm high on a white background.
- f) 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.

3.2.12 Requirements for sulphur hexafluoride (SF6) gas (where applicable)

Note: Requirements below, where applicable, shall be fulfilled by the Supplier for all Disconnecting circuit-breakers that are using environmental friendly insulation and/or extinguishing medium. Furthermore, the Supplier shall provide additional specific details.

- a) SF6 gas used as an insulation and/or extinguishing medium shall comply with the requirements of IEC 60376.
- b) When installation is called for, SF6 Disconnecting circuit-breakers shall be filled with new SF6 gas at the rated normal pressure. All SF6 Disconnecting circuit-breakers shall be factory filled with new SF6 gas at the rated transportation pressure. This shall be applicable to other environmental friendly insulation and/or extinguishing medium.

ESKOM COPYRIGHT PROTECTED

-
- c) The maximum SF6 gas leakage rate for the complete equipment shall be 0,5 % per year. The leakage rated offered shall be stated in Schedule B. This shall be stated for all the gas in the equipment as well as for any individual gas-filled compartment.
- d) A certificate guaranteeing SF6 purity to IEC 60376 shall be supplied with the DCB. Upon filling and testing the DCB, a SF6 purity analysis shall be carried out by the Supplier not less than 7 days after commissioning or as recommended by the OEM. All gas filling shall be done by an accredited person. The following parameters shall be checked, recorded and a report submitted to Eskom after filling:
- SF6 content (purity) - not less than 98%
 - Dew-point (humidity/ moisture content) maximum, at rated filling pressure and +20°C – at commissioning shall not be above -10 °C. When equipment is in service it shall not exceed the critical limit of -5 °C.

Note: As the reference unit, in accordance with SANS NRS 087:2008 clause E.1.1 the volume concentration of the moisture contained in a gas shall be expressed in microliters per litre (µL/L).

- e) The following requirements are applicable to SF6 gas-filled DCB filling and pressure monitoring (also the other environmental friendly insulation and/or extinguishing medium):
- In the case of Disconnecting circuit-breakers for use in systems of nominal voltage up to and including 132 kV, gas filling/evacuation points with DILO DN8 connections shall be provided.
 - In the case of Disconnecting circuit-breakers for use in systems of nominal voltage from 220 kV up to and including 765 kV, gas filling/evacuation points with DILO DN20 connections shall be provided.
 - Access to gas filling/evacuation points shall be at a height of not more than 2 400 mm above ground level. This allows for access to the filling/evacuation point without leaving the ground level.
 - The gas filling/evacuation point and the gas pressure gauge shall be separated i.e. it shall not be necessary to remove the pressure gauge in order to access the filling/evacuation points.
 - A dial type gauge responding to medium density and indicating pressure compensated for temperature shall be suitably sized (typical 80-100 mm diameter).
 - A medium density monitoring device (density switch), which may also be integrated into the dial type gauge as a dual function device, shall be provided. The density monitoring device switch shall provide the necessary contacts specified in 240-56030489.
 - Pressure gauges shall be numerically marked and calibrated in Pascal's (kPa or MPa). Gauges shall measure "absolute" pressure and shall be clearly labelled 'ABSOLUTE'. Rated pressure shall be no more than 80% of the full-scale reading.
 - The density monitoring device shall be suitable for outdoor application and resistant to operating vibrations, outdoor elements (hail/snow), etc.
 - The type of gauge utilised shall be designed such as to prevent any corrosion of moving parts and contacts inside the gauge.

Note: Gauges filled with an inert gas to prevent corrosion and the ingress of moisture are acceptable.

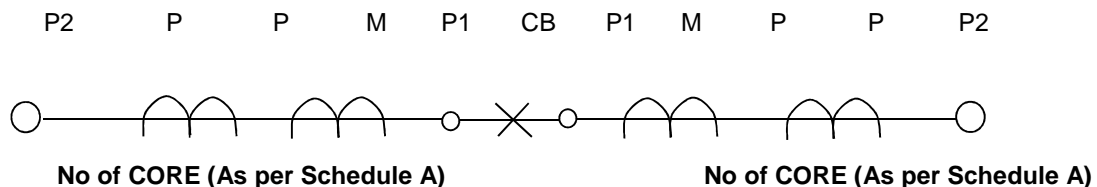
- Medium density monitoring devices shall be shielded against direct sunshine and internal operating mechanism enclosure heater elements which could give rise to false readings and alarms.
- Non-return valves shall be fitted on all DN8 / DN20 fittings and pipe-work such that the gas pressure is maintained in the system and pipe-work when a DCB pole or the density monitoring device is removed / disconnected. The Supplier shall submit details of the arrangements offered together with the tender documentation (refer to 3.2.23.1).

ESKOM COPYRIGHT PROTECTED

- Any pipe work shall be made of stainless steel and mounted in such a manner that it is mechanically protected. The use of copper pipes is acceptable if painted in the factory before mounting to the DCB common base frame.
 - For Disconnecting circuit-breakers with physically separated poles and associated operating mechanisms, a separate filling/evacuating and medium density monitoring point per pole shall be provided. For Disconnecting circuit-breakers with a common base frame, a single common filling/evacuating and medium density monitoring point for all poles may be provided.
 - Electrical connections to the density monitoring device shall preferably not be the plug-in type. However, density-monitoring devices with locking facilities will be accepted.
 - Cabling to the medium density monitoring device shall be secured, protected from the elements and run into enclosures through a suitable compression gland or rubber grommet.
 - Complete details of all insulation and/or extinguishing medium pressure devices, including drawings, manufacturer's specifications, performance and test data, details of production tests and a quality control programme, shall be included with the tender documentation (refer to 3.2.23.1).
 - Electrical interlocking devices and alarms provided by the gas density monitoring device shall be in accordance with 240-56030489.
- f) The management of SF6 gas shall be in accordance with NRS 087.

3.2.13 Current transformers (CTs) for dead-tank Disconnecting circuit-breakers

- a) Current transformers (CTs) shall be of the integrated ring-type, manufactured and tested in accordance with IEC 61869-1, SANS 60044-1 (IEC 61869-2), SANS 60044-6 and NRS 029 (IEC 61869-6).
- b) The number and type of CT cores required per phase, together with their position relative to the DCB and their respective standards or specifications will be specified in schedule A.
- c) The CT terminal numbering and wiring interface shall be in accordance with the drawing specified in schedule A.
- d) It shall be possible to remove and replace the ring-type CTs without dismantling the DCB bushing. The method to perform this shall be provided with tender documentation.
- e) Specific requirements for dead-tank DCB CT's:-



Note: P1 and P2 are indicating the dead-tank DCB's HV bushings main terminal and plug-in point

Figure 2: Typical arrangement of the CTs on the dead-tank DCB

3.2.13.1 Cores and class for CT's on dead-tank Disconnecting circuit-breakers

For Feeder bays, Coupler bays and Transformer bays CT's on dead-tank Disconnecting circuit-breakers

- 1) 765kV CT's:

Number of CT cores: 4 x Protection class TPY; 2 x Metering class 0.2

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **38 of 107****Table 9: 765kV ratios for multi ratio (MR) and fixed metering current transformers**

Nominal ratio	Proposed Tapping points on secondary windings	Ratios available	Burden capability VA	Accuracy class	Ratio
3200/1	800/800/1200/400	3200/2800/2400/2000/1600/1200/800/400/1	10	0,2	800/1
800/1*	Fixed	800/1	10	0.2	800/1

Note: The asterisk (*) on the nominal ratio denotes that it is requirement for the 765kV Reactor Dead-tank Disconnecting circuit-breakers

Table 10: 765kV ratios for multi ratio (MR) and fixed protection current transformers

Nominal ratio	Proposed Tapping points on secondary windings	Ratios available	Maximum secondary winding resistance at 75°C(1)	Class	Ea/	Double duty cycle
3200/1	800/800/1200/400	3200/2800/2400/2000/1600/1200/800/400/1	12.8	TPY	2000	C-O-C-O
800/1*	Fixed	800/1	12.8	TPY	2000	C-O-C-O

Note: The asterisk (*) on the ratio denotes that it is the requirement for the 765kV Reactor Dead-tank Disconnecting circuit-breakers

Table 11: Values where TPY cores are used on dead-tank Disconnecting circuit-breakers

	Unit	765kV CT	400kV CT in Trfr Bay
Current transformer class		TPY	TPY
Number of Protection cores		4	2
Rated primary current (I_{pn})	A	3150	3150
Rated secondary current	A	2	2
Rated frequency	Hz	50	50
System voltage and insulation level	kV	765	400
System voltage and insulation level	kV	1550	1050
I_{th} (I_{psc})	kA	50 for 1 sec	50 for 1 sec
I_{dyn}	kA	127.5	127.5
Ratio to which specified data applies	-	3200/1 (MR)	3200/1 (MR)
I_{kf} (Symmetrical short circuit)	-	20	20
K_{ssc} (Asymmetrical short circuit)	-	15	15
T_p	msec	100	100
DC Component	%	55	55
Duty cycle: Single: t' , t'_{al} ; Double: t' , t'_{al} , t_{fr} , t'' , t''_{al}	msec	100	100
Duty cycle: Single: t' , t'_{al} ; Double: t' , t'_{al} , t_{fr} , t'' , t''_{al}	msec	40	40
Duty cycle: Single: t' , t'_{al} ; Double: t' , t'_{al} , t_{fr} , t'' , t''_{al}	msec	500	500
Duty cycle: Single: t' , t'_{al} ; Double: t' , t'_{al} , t_{fr} , t'' , t''_{al}	msec	100	100
Duty cycle: Single: t' , t'_{al} ; Double: t' , t'_{al} , t_{fr} , t'' , t''_{al}	msec	40	40
R_b	Ω	12	12

- CT requirements for Shunt Reactor bays: Number of CT cores:

Dead-tank DCB CT's: 2 x Protection class TPY (fixed 800/1) and 1 x Metering class 0.5 @ 800/1 5VA

ESKOM COPYRIGHT PROTECTED

Table 12: Values for the 765kV Reactor dead-tank DCB

	Unit	Dead-tank DCB CT
Current transformer class		TPY
Rated primary current (I_{pn})	A	800
Rated secondary current	A	2
Rated frequency	Hz	50
System voltage	kV	765
Insulation level	kV	1550
I_{th} (I_{psc})	kA	50 for 1 sec
I_{dyn}	kA	127.5
Ratio to which specified data applies	-	800/1 (Fixed)
A_{lf} (Symmetrical short circuit)	-	20
K_{ssc} (Asymmetrical short circuit)	-	15
T_p	msec	100
DC Component	%	55
Duty cycle: Single: t' , t'_{al} ; Double: t' , t'_{al} , t_{fr} , t'' , t''_{al}	msec	100
Duty cycle: Single: t' , t'_{al} ; Double: t' , t'_{al} , t_{fr} , t'' , t''_{al}	msec	40
Duty cycle: Single: t' , t'_{al} ; Double: t' , t'_{al} , t_{fr} , t'' , t''_{al}	msec	500
Duty cycle: Single: t' , t'_{al} ; Double: t' , t'_{al} , t_{fr} , t'' , t''_{al}	msec	100
Duty cycle: Single: t' , t'_{al} ; Double: t' , t'_{al} , t_{fr} , t'' , t''_{al}	msec	40
R_b	Ω	12

2) 220kV – 400kV CT's:

Number of CT cores: 2 x Protection class TPS; 2 x Bus Zone class TPS; 2 x Metering class 0.2

Note: The 400kV dead-tank DCB used on the 765kV transformer bay on the 400kV side shall have the core requirements: 2 x Protection class TPY; 2 x Bus Zone class TPS; 2 x Metering class 0.2

3) 132kV CT's:

Number of CT cores: 2 x Protection; 2 x Bus Zone; 2 x Metering.

Note: Class as per NRS 029 and 240-56062864 Table 2.

3.2.13.2 Magnetizing curves

Details of magnetizing curves (on a log-scale) for the dead-tank Disconnecting circuit-breakers CT's shall be provided for the TPY cores with tender documentation. The other cores' magnetizing curves shall be provided upon Eskom request.

3.2.14 Switching surge control (where applicable)

- The method for switching surge control shall be submitted with the tender documentation, and will be subject to approval by Eskom. The use of grading capacitors and pre-insertion resistors parallel to the interrupters are NOT acceptable.
- For the switching of capacitor banks, reactor banks and transformers, the preferred solution for switching surge control is by means of precise and repeatable operating characteristics in conjunction with an electronic controller (refer to 3.2.18).

ESKOM COPYRIGHT PROTECTED

- The electronic controller shall be IEC61850 protocol compliant. The technical details of this device shall be submitted with the tender documentation and shall be subject to Eskom's approval.

3.2.15 Grading capacitors (where applicable)

- a) Where the distribution of voltage stresses across the interrupters of Disconnecting circuit-breakers having two or more interrupting units in series is required, this method shall NOT the use of grading capacitors. The method used by the manufacturer shall be stated in the tender documentation and schedule B together with the test values the method is rated for.
- b) The Supplier shall provide details with the tender documentation (refer to 3.2.23.1) of how to verify the condition of the method for voltage distribution during the life of the DCB. The method used is required to last for the lifetime of the DCB without maintenance.

3.2.16 Extreme asymmetrical short-circuit interrupting capability (where applicable)

If required, the capability of the DCB to interrupt short-circuit currents with a higher degree of asymmetry than required by the SANS 62271-100 standard will be specified by Eskom in schedule A. Details will be provided with the tender documentation. Such capability shall be demonstrated by tests or calculations that show that the influence of the arc voltage will produce a current zero within the normal arcing time of the DCB.

Note: Disconnecting circuit-breakers typically placed on the high-voltage side of large generator step-up transformers may experience short-circuit currents that may, due to the extreme asymmetry of the short-circuit current, not have a current zero for a number of cycles, preventing interruption of the current. In such circumstances, the duty of the DCB can be eased, for example, by delaying its opening. Alternatively, it may be proven by tests or calculations that the arc voltage of the DCB is high enough to damp the d.c. component of the current so much that a current zero will occur.

3.2.17 Requirements for simultaneity of poles during single closing and single opening operations

- a) All interrupters in a pole and in all three poles of the DCB shall operate simultaneously on opening and closing – including infrequent operation and under extreme temperature conditions. Contact synchronism shall be retained within rated values during the expected maintenance intervals of the Disconnecting circuit-breakers. The expected degree of synchronism shall be in accordance with SANS 62271-100 and therefore as follows:
 - the time interval between contact touch for all poles of the DCB shall not exceed 5 ms (a quarter of a cycle of rated frequency);
 - the time interval between contact touch for interrupters in the same pole shall not exceed 3,3 ms (a sixth of a cycle of rated frequency);
 - where applicable, the time interval between contact touch for individual pre-insertion closing resistors shall not exceed 10 ms (a half of a cycle of rated frequency); and
 - where applicable, the time interval between contact touch for individual pre-insertion closing resistors in the same pole (series connected) shall not exceed 6,6 ms (a third of a cycle of rated frequency);
 - the time interval between contact separation for all poles of the DCB shall not exceed 3,3 ms (a sixth of a cycle of rated frequency); and
 - the time interval between contact separation for interrupters in the same pole shall not exceed 2,5 ms (an eighth of a cycle of rated frequency);
- b) Refer to 5.101.1 of SANS 62271-302 for general guidance for Disconnecting circuit-breakers intended for operation with intentionally non-simultaneous poles (controlled switching - refer to 3.2.18).

3.2.18 Controlled switching

Notes:

- For switching of shunt capacitor banks, shunt reactors and power transformers, Disconnecting circuit-breakers supplied may be required to perform controlled (point-on-wave) switching duties. The Supplier shall provide all accessories and cabling required for the point-on-wave relay.
 - SANS 62271-302 provides guidance on the design, construction, specification and testing of Disconnecting circuit-breakers with intentional non-simultaneous pole operation which are excluded from the scope of SANS 62271-100. Disconnecting circuit-breakers with intentional non-simultaneous pole operation are mainly used for the implementation of controlled switching.
 - The Supplier shall provide proof that the controlled switching device (point-on-wave) is compliant to IEC61850 protocol with the Tender documentation.
 - The controller and its associated circuitry are to be provided as a separate contract item.
 - The controller and its associated circuitry are located at a remote location in the control room associated with the particular DCB.
 - Mechanically staggered poles used for controlled switching applications will not be accepted due to the limitation placed on the DCB mechanical endurance, unless otherwise accepted by Eskom.
- a) Full details of the controlled switching system offered, i.e. the manufacturer's technical specification/manual for the controller and necessary sensors and auxiliary equipment required to achieve controlled switching, shall be supplied with the tender documentation (refer to 3.2.23.1). However, the DCB shall be capable of switching without the use of a controlled switching system.
- b) The Supplier shall state in schedule B whether the DCB offered has been tested in accordance with SANS 62271-302. The Supplier shall indicate whether the DCB offered was tested independent from any particular controller or whether it was tested with a dedicated controller and the necessary sensors and auxiliary equipment which form part of the tested equipment.
- c) The Supplier shall provide details with the tender documentation (refer to 3.2.23.1) regarding the mechanical characteristics of the DCB which affect the mechanical operating time, e.g. influence of ambient temperature, substation d.c. control voltage, standing time, operating pressure, contact wear. The cause of deviations in operating times shall be indicated in all cases, e.g. arising in the operating coil/latch assembly, energy storage device, etc.
- d) The Supplier shall provide details with the tender documentation (refer to 3.2.23.1) of the DCB dielectric characteristic – as a function of time (closing) and as a function of SF6 gas filling pressure up to the maximum rated design pressure. The Supplier shall also supply the upper and lower limits of the dielectric characteristic which can be expected over the service life of the DCB. The critical arcing time window shall be indicated for re-ignition-free shunt-reactor switching. For controlled closing of shunt capacitor banks as well as for controlled opening of shunt reactors, a tolerance of less than ± 1 ms is required as a function of the above mentioned parameters. If special measures are required to maintain operating times within these limits, this shall be stated with the tender documentation.

3.2.18.1 Additional requirements for the point-on-wave controller for digital secondary plant interface option

The point-on-wave switching controller shall form an additional Process Interface Unit (PIU) in the digital secondary plant interface to the switchgear as per clause 3.2.21.1.

The point-on-wave switching controller shall implement the IEC 61850 logical node CPOW – Control Point-on-wave switching.

3.2.19 Pole discordance (PD) or phase discrepancy

Notes:

- A pole discordance (PD) or phase discrepancy condition is when one or more poles of a single-pole operated DCB (i.e. "1P") do not perform an operation in harmony with the other poles.

ESKOM COPYRIGHT PROTECTED

-
- The PD timer and its associated circuitry are to be provided as a separate contract item.
 - This timer will receive its signal from a combination of normally-open and normally-closed auxiliary switch contacts.
 - The PD timer and its associated circuitry are located on the control panel at a remote location in the control room associated with the particular DCB.
- a) If a pole discordance condition persists for at least 100 ms, then the control circuitry associated with the DCB shall immediately initiate a trip command to all poles. The duration for which the discordance condition persists before tripping all poles, shall be controlled using a settable timer.
- b) In order to determine the correct settings for this PD timer, the Supplier shall provide the following information with the tender documentation (refer to 3.2.23.1) about the timing events (with tolerances) between:
- main contact timing and the auxiliary contacts timing of the same pole for both opening and closing operations;
 - main contact timing and the auxiliary contacts timing between all poles for both opening and closing operations assuming the open and close command is received simultaneously by all poles; and
 - designation of auxiliary contacts (required for future testing);
- c) In the case of single-pole auto-reclosing, where an intentional PD will exist for times in excess of 1 000 ms, the control circuitry shall deliberately permit this condition.

3.2.20 Auxiliary and control circuits

- a) The auxiliary and control circuits shall be designed and implemented in accordance with the requirements of 240-56030489.
- b) In the case of Disconnecting circuit-breakers for use in systems of nominal voltage up to and including 132 kV, the DCB auxiliary and control circuit wiring interface shall be in accordance with D-DT-5407. In the case of Disconnecting circuit-breakers for use in systems of nominal voltage above 132 kV, the wiring interface shall be in accordance with 0.54/07529 (Live-tank Disconnecting circuit-breakers) and 0.54/8557 (Dead-tank Disconnecting circuit-breakers). These schematics shall be applicable to equipment with the higher rated voltages.
- c) A removable 3 mm thick brass or aluminium gland plate (undrilled) having a minimum usable area of 200 mm x 100 mm shall be fitted at the bottom of the enclosure below the terminal strips for the bottom entry and glanding of all control cables. The gland plate shall be secured by a minimum of six M8 set screws with nuts and washers, unless otherwise approved by Eskom. In the case where CTs are supplied with the DCB, two gland plates each having a minimum usable area of 200 mm x 100 mm shall be fitted below each terminal strip. Earthing of the gland plate shall be via the set screws.
- d) To facilitate LV control cable entry and connection, the distance between any part of the terminal strip and the gland plate shall not be less than 150 mm. The terminal strips shall be positioned and spaced to provide easy access to the terminals to insert the wiring.
- e) A suitable earthing point shall be provided inside the operating mechanism enclosure to allow earthing of at least 10 spare secondary control cabling cores. This shall be achieved using a tinned copper earthing bar with M6 fasteners or a suitable number of earthed terminal blocks.
- f) Induced electromagnetic disturbances in the secondary system of the DCB shall not cause spurious operation or damage. This applies under both normal operation and switching conditions, including interruption of fault currents in the primary system.
- g) It shall be possible to change the d.c. control voltage at which the DCB operating mechanism operates by only replacing the opening and closing coils, operating mechanism motors and motor contactor coils.

Notes:

ESKOM COPYRIGHT PROTECTED

- 1) Switchgear shall only be required to operate at one d.c. control voltage 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 d.c. or 220 V d.c. as specified in schedule A.
- 2) A readily available d.c. supply voltage "conversion kit" may be required by Eskom from the Supplier in order to convert the DCB operating mechanism from 110 V to 220 V d.c. or vice versa. Refer to 0.

3.2.20.1 Requirements for the digital secondary plant interface option

An option shall be provided for a digital interface to the auxiliary and control circuits based on IEC 61850 [32] GOOSE Messaging. The digital interface shall be applicable to binary controls and binary status signals. Analogue instrument transformer signals (where applicable) shall be retained, that is implementation of IEC 61850 Sampled Measured Values is not required. The digital interface shall be achieved via Intelligent Electronic Devices (IEDs) to be referred to herein as Process Interface Units (PIUs).

The digital interface shall be an add-on option to the standard wiring interface of the switchgear, and shall be installed within the mechanism box, or in an additional bolt-on enclosure which shall be provided. The mechanism box/enclosure shall also be able to accommodate the point-on-wave closing controller. All wiring between the PIUs and the interface terminal strips shall be provided.

The digital interface shall be in accordance with SANS 62271-3. In particular:

- a) The PIUs shall be specified to conformance class b ("including the services required to implement the complete IEC 61850 series' data model with self-descriptive capabilities") or higher.
- b) The ACSI basic conformance shall include B11 (Server side of Two Party Application Association), B31 (GSE Publisher side) and B32 (GSE Subscriber side).
- c) The total processing delay of the communication device (t_1) for trip and close signals for primary switchgear rated above 145kV shall be less than or equal to 7 ms. The processing delay for all other signals shall be less than or equal to 12 ms.

Two physically separate PIUs shall be provided. Separate auxiliary DC power supplies shall be provided by the Purchaser for each PIU. Each PIU shall be provided with all status and alarm contacts relating to the switchgear and the additional alarms indicated below. The "Main" PIU shall control the main tripping coil. The "Main 2"/"Back-up" PIU shall control the back-up tripping coil. Both PIUs shall have control over the closing coil by means of a dedicated DC supply (via the point on wave closing controller where applied).

The functions specified for a specific PIU may be distributed amongst multiple devices, but the physical separation of the main (1) and back-up/main 2 PIUs shall be retained.

PIUs shall be specified in accordance with Eskom Standard [35] 240-6465228. In particular, the devices:

- a) Shall be rated for operating over the temperature range -25°C to +70°C (Section 3.1.1) without forced cooling.
- b) Shall be equipped with a multi-session fibre optic Ethernet port in accordance with Section 3.16. Alternatively, separate optical Ethernet ports may be provided for IEC 61850 [32] communication and remote engineering access.

Suppliers/ Tenderers shall complete the Schedules A&B of Eskom Standard 240-6465228 [35] which have been tailored for PIU devices.

The PIU hardware design shall allow for the unplugging of all interface wiring without the need to disconnect individual wires. Pre-wired test plugs shall be available for the input and output wiring, allowing the normal interface wiring plugs to be substituted by testing plugs for test purposes (i.e. to connect the PIU inputs and outputs to a secondary injection test set). All plugs shall be keyed so as to avoid replacement into the incorrect sockets. Keying of plugs shall be user settable and re-settable.

The PIUs shall support the following minimum sets of logical nodes in accordance with IEC 61850-7-4 and Eskom Standard 240-42066934 [34]. The PIUs shall support sufficient instances of the logical nodes and binary inputs and output contacts for the intended application.

- a) LPHD – System: Physical device
- b) CSWI – Control: Switch controller (circuit-breaker, disconnectors, earthing switches)

ESKOM COPYRIGHT PROTECTED

- c) SCBR – Supervision and monitoring: DCB monitoring
- d) SIMG – Supervision and monitoring: insulation medium supervision (gas) and/or SIML – Supervision and monitoring: insulation medium supervision (liquid) as applicable
- e) SSWI - Supervision and monitoring: circuit-switch monitoring (for integral disconnectors and/or earthing switches)
- f) XCBR – Switchgear: Circuit breaker
- g) XSWI – Switchgear: Circuit switch (for integral disconnectors and/or earthing switches)

The digital interface IEDs shall have sufficient binary inputs and Logical Nodes for the assimilation and communication of the following additional alarms:

- a) Main/Back-up DC supply fail (cross reporting by the main and back-up IEDs)
- b) Closing DC supply fail
- c) Motor DC supply fail
- d) Main/Back-up IED unhealthy (cross reporting by the main and back-up IEDs)
- e) Point-on-wave device unhealthy
- f) Spring charged

The IEC 61850 Protocol Implementation Extra Information (PIXIT) requirements for the GSE Model and the Time Synch Model and the Technical Issue Conformance (TICS) requirements shall be in accordance with Eskom Standard 240-68107841.

It shall be possible to place the digital interface IEDs in a test mode whereby output contact operation is blocked, yet information regarding attempted contact operation is made available via (preferably) IEC 61850 Edition 2 test mode (see IEC 61850-7-1 Section 7.8.4) and/or an engineering personal computer that is temporarily connected to the network. Simulation of binary inputs shall be supported.

3.2.21 Nameplates

- a) The DCB nameplate shall contain the necessary information specified in SANS 62271-108. The nameplate shall consist of the following:
 - Eskom order and contract number
 - Eskom stock (SAP) number
 - Rated single-phase short-circuit breaking current - where applicable (refer to b))
- b) The operating device nameplate shall contain the necessary information specified in SANS 62271-108, which includes the rating for both the circuit-breaker and disconnector. Also the following:
 - Trip-coil rated voltage, current, d.c. resistance (at 20 0C)
 - Close-coil rated voltage, current, d.c. resistance (at 20 0C)
 - Motor rated voltage and current (starting peak current and nominal running current)

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

- c) Disconnecting circuit-breakers tested in accordance with SANS 62271-302 for controlled switching should make specific reference to SANS 62271-302 on their nameplates. The nameplates of Disconnecting circuit-breakers intended for controlled closing should indicate the rated making window in accordance with SANS 62271-302.

-
- d) The nameplates and their fixings shall be weather-proof and inherently corrosion-resistant. They shall be either engraved aluminium or stainless steel and are subject to approval by Eskom. All the letters and figures on the nameplates shall be permanently marked. The nameplates shall be securely fastened to the equipment in a reliable manner as in 3.2.12 f (requirement for labels). The method used shall be stated in schedule B. The nameplate material offered shall be stated in schedule B.
- e) Where applicable, duplicate nameplates of the CTs shall be attached to the inside of the operating mechanism enclosure front access door in order for them to be read from ground level. The details on the nameplates shall be in accordance with NRS 029.
- f) The actual ratings to which the DCB has been type-tested (and not merely the values specified) shall be displayed.

3.2.22 Tools and spares

- a) A full set of operating tools necessary to carry out all mechanical (manual) operations of the DCB shall be supplied with each DCB (e.g. racking handle, spring charging handle, etc.). A full list of operating tools shall be provided with the tender documentation (refer to 3.2.23.1). If additional sets of operating tools are required, this will be specified in schedule A.
- b) All operating tools shall be fitted on the inside of the front access door of the operating mechanism enclosure.
- c) A detailed list of standard tools required for minor maintenance shall be supplied with the tender documentation (refer to 3.2.23.1). Where applicable, the following tools are required for minor maintenance:
- slow operating device(s);
 - hoses and fittings for draining and filling with SF6 gas or other insulation and/or extinguishing medium; and
 - other tools which may be required (e.g. contact alignment tools, insulation and/or extinguishing medium density meter checking device).
- d) Should the DCB require additional specialised tools for major maintenance purposes, a full list of specialised maintenance tools shall be provided with the tender documentation (refer to 3.2.23.1).
- e) A full list of spares required for maintenance shall be provided with the tender documentation (refer to 3.2.23.1).
- f) The Supplier shall provide the written letter with the tender documentation that states that in case of the design obsolescence, they shall notify Eskom and present all spares manufacturing drawings and specification (i.e. metal, Bill of material, masses) for the maintenance spares required for DCB and where applicable, with its earthing switch, life expectancy.

3.2.23 Documentation requirements

3.2.23.1 The documentation to be submitted with tender documentation

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

- a) completed technical schedule B for each DCB 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", etc. is not acceptable;

-
- b) a full set of general arrangement (GA) drawings of the DCB, where applicable with its integral (in-built) earthing switch, showing the following minimum information:
- 1) manufacturer's drawing number and revision number. Provision shall be made for an Eskom-allocated drawing number as well as for the Eskom contract number - for population after awarding of the contract;
 - 2) a descriptive title of the drawing (e.g. "400 kV 3150 A 1-pole Operated DCB General Arrangement");
 - 3) 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 operating mechanism enclosure above ground, operating mechanism enclosure dimensions, overall height, width and depth of DCB, etc.;
 - 4) properly annotated drawing with a complete list of major components (bill of materials);
 - 5) details of main terminals including dimensions of the fixing holes, terminal hole spacing, plate thickness and maximum permissible forces (loads) on main terminals (with directions) expressed in Newtons (N);
 - 6) details of the main earthing terminal and operating mechanism enclosure earthing terminal;
 - 7) mass of DCB in kilograms (kg), which shall include the empty mass, mass and description of heaviest component, total mass of DCB ready for service and mass of filling medium;
 - 8) any special trenches or steelwork required between phases;
 - 9) the steel support structure dimensioned outline and general arrangement;
 - 10) the steel support structure label mounting holes;
 - 11) in the case where the steel support structure is designed by the manufacturer, the steel support structure earthing terminal;
 - 12) the concrete foundation dimensioned outline, design detail and general arrangement;
 - 13) mounting and fastening arrangement for the DCB support structure onto the foundation including the minimum required length and diameter of foundation holding down bolts as well as the relative position of levelling nuts, spacers, washers, etc. in relation to the base plate;
 - 14) maximum torque required for the foundation holding down bolt nuts used to secure the support structure base plate (Nm);
 - 15) static and dynamic forces (loads), centre of gravity - refer to 0.
 - 16) relative location of DCB poles, base frame, operating mechanism enclosure(s), method used for voltage distribution across multiple interrupter units (where applicable) and closing resistors (where applicable);
 - 17) location of all enclosure doors and handles;
 - 18) location and annotation of control facilities (gas filling/evacuation points, SF6 density monitoring device with its environmental protection shelter/cover, etc.);
 - 19) location and layout of LV control cable gland plates;
 - 20) insulation and/or extinguishing pressure and quantity requirements; and
 - 21) location of nameplate on DCB;
- c) for all external insulation (i.e. post-insulators, DCB chamber insulators, bushings, etc.), detailed drawings showing the insulator material, shed profile dimensions including shed and insulation body/core diameters, shed spacing, creepage distance and dry arcing distances, etc.;

-
- d) drawings showing the generic layout of all the nameplates (DCB, operating device(s), CTs) in accordance with 3.2.21. Provision shall be made for an Eskom-allocated drawing number as well as for the Eskom contract number - for population after awarding of the contract;
 - e) generic auxiliary and control circuit schematic wiring diagrams for the DCB. Provision shall be made for an Eskom-allocated drawing number as well as for the Eskom contract number - for population after awarding of the contract;
 - f) a general arrangement drawing of the operating mechanism enclosure. Provision shall be made for an Eskom-allocated drawing number as well as for the Eskom contract number - for population after awarding of the contract;
 - g) full list of spares required for maintenance (refer to e) and section 3.5.1)
 - h) full list of operating tools (refer to a));
 - i) detailed list of standard tools required for minor maintenance (refer to c));
 - j) detailed list of additional specialised tools for major (specialised) maintenance (refer to d));
 - k) full list summary of type-tests as well as copies of type test reports and/ or certificates (refer to 3.3.1.2);
 - l) generic routine test certificates for the DCB (refer to 3.3.1.2);
 - m) transport, storage, installation, operating and maintenance manuals (refer to section 3.4);
 - n) training material (refer to section 3.7); and
 - o) generic quality inspection and test plan (QITP), for manufacturing up to site installation and pre-commissioning testing.
 - p) the submission, where applicable, of the following additional information:
 - 1) premature failures experienced in service of similar design Disconnecting circuit-breakers supplied elsewhere by the manufacturer, together with the recommended modifications (refer to g));
 - 2) where applicable, details of any special equipment required to view all DCB status indications and make necessary readings from the ground level (refer to f));
 - 3) details of corrosion protection and lubricants offered (refer to d));
 - 4) measures taken to prevent flange corrosion (refer to e));
 - 5) where applicable (i.e. dead-tank Disconnecting circuit-breakers), details of the internal arc behaviour of the DCB (refer to d))
 - 6) details of the arrangements offered to maintain insulation and/or extinguishing medium pressure in the system when the DCB or a pole is removed or replaced (refer to e) point 11);
 - 7) details of all insulation and/or extinguishing medium pressure devices, including drawings, manufacturer's specifications, performance and test data, details of production tests and a quality control programme (refer to e) point 16);
 - 8) information on how to verify the condition of the method used for voltage distribution on multiple interrupter design during the DCB life (refer to 3.2.15);
 - 9) information required for controlled switching (refer to 3.2.18);
 - 10) information about the timing events for PD timers (refer to a));
 - 11) quality control plans indicating all inspection hold points (refer to c));
 - 12) details of equipment requiring maintenance during storage (refer to a));
 - 13) a written commitment from the Supplier regarding the submission of the maintenance DVD (refer to 3.5.2); and

- 14) spares availability philosophy (refer to 3.5.3.2).
- q) the a maintenance outage disconnecting device requirement;
- r) the detailed list of references where the DCB type has been supplied by the OEM.

3.2.23.2 The documentation to be delivered with each DCB

Unless otherwise specified in schedule A, the manufacturer shall submit the following documentation with each DCB delivered to Eskom:

- a) an auxiliary and control circuit schematic wiring diagram of the DCB;
- b) a complete set of routine test certificates;
- c) a commissioning and hand-over test sheet;
- d) one set of transport, storage, installation, operating and maintenance manuals. If the order and delivery contains sensitive electronic devices such as the Electronic Controller, the Supplier shall communicate the storage requirements upfront and clearly mark the packaging accordingly; and
- e) a maintenance outage disconnecting device facility and its special tools.

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

3.2.23.3 Storage of supplied documents

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

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

3.2.23.4 Documents to be supplied upon awarding or contract

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

- a) DCB analyser data required for condition monitoring (refer to 3.5.5);
- b) detailed scope of works (job plan) for each type of prescribed maintenance intervention;
- c) detailed work instructions (task manual) for each type of prescribed maintenance intervention; and
- d) detailed works reports (check sheet) for each type of prescribed maintenance intervention.
- e) quality inspection and test plan (QITP) in accordance with QM-58 clause 6c and Annex I.

3.2.24 Packaging and preservation requirements

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

Note: Eskom will not accept equipment if the various components of the different Disconnecting circuit-breakers are delivered in the same packing containers.

- b) All DCB 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). Refer to QM-58 how to handle preservation.
 - It shall be the responsibility of the Supplier to inform Eskom on how to store onsite the sensitive electronic devices such as Electric Controllers with each order. These shall be clearly marked.
- c) Durable waterproof packaging shall prevent damage to the DCB components during transportation and storage on site and shall be such that suitable ventilation is allowed in order to minimise condensation.

ESKOM COPYRIGHT PROTECTED

-
- 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 DCB, each crate shall be clearly and sequentially marked in order to identify each crate as belonging to a specific DCB (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;
 - short DCB description (including the rated voltage, normal current, rated short-circuit breaking current, auxiliary d.c. control voltage; specific creepage; "1P" or "3P") ;
 - manufacturer's name (i.e. make of DCB);
 - manufacturer's DCB product designation/code (i.e. type of DCB);
 - manufacturer's serial number(s);
 - contents of the crate (i.e. a parts list);
 - the crate number (e.g. "CRATE 1 of 2", "CRATE 2 of 2");
 - the crate overall dimensions (in mm); and
 - total mass of each crate (e.g. "TOTAL MASS: 1000 KG");
 - pictograms / symbols showing correct storage and stacking instructions for crates
- g) Exposed shafts, bearings and machined surfaces shall be treated with a temporary anti-corrosive coating.
- h) Loose components or components that are subject to damage from exposure to dust or water shall be packed in hermetically sealed plastic bags.
- i) All components shall be clearly marked. Components that are physically impossible to mark shall be individually packed and the packaging shall be marked.
- j) Fork-lift lifting points shall be provided on the packaging, where applicable. These points shall be braced as though it were a lifting pallet (for mechanical support during lifting activities).
- k) A readily accessible (i.e. without the need to remove / disturb the external packaging) external temporary 230 V a.c. supply connection point for the heater circuit during storage shall be provided and wired to the Eskom side of the terminal strip in the factory. This shall consist of an electrical cord wired to a screw-type connection block for the connection of the temporary a.c. supply used during storage. Heater connections shall be designed in such a manner so as not to cause a hazardous situation when energised. No internal wiring should need be modified to remove the temporary supply leads. The connection point shall be labelled "230 V AC HEATER CONNECTION: CONNECT IF STORED > 2 DAYS" or similar.
- l) A non-resettable impact recorder/detector shall be provided and located in such a position so as to record/detect the acceleration of the DCB body and not the packaging.
- m) Where applicable, the DCB shall be transported with a positive gas pressure of maximum 150 kPa.
- n) A copy of the BOM shall be provided with the delivery note for each DCB supplied in order to allow the recipient to confirm that all items on the BOM have been delivered, and for record purposes.

3.3 Tests

3.3.1 General

- a) Manufacturer's testing capabilities

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

3.3.1.1 Witnessing of tests

Eskom reserves the right to be present at any of the tests specified. The Supplier shall ascertain the sequence of tests required in each particular case and whether witnessing of tests is required, and, after completion of all preliminary tests, shall then give Eskom sufficient, agreed upon, advanced notice of the firm date when the DCB and associated apparatus will be ready for the witnessing of testing.

Note: Where applicable, the minimum required notification period for overseas travel from South Africa is 8 weeks.

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

3.3.1.2 Test certificates and reports

- a) Type test reports and/or certificates together with each complete summary of type test (in English) shall be supplied with the tender documentation (refer to 3.2.23.1). The type test reports and/or certificates and the summary of type tests shall be in both printed copy and in electronic Portable Document Format (PDF). The type test reports shall be in electronic Portable Document Format (PDF).
- 1) The type test certificate which is the proof of official accreditation shall have the official signatures of the accredited test laboratory where the type-tests were performed which is responsible for its validity and contents. The type test certificate shall contain a record of series of type-tests carried out strictly in accordance with the IEC standard. It shall contain essential drawings and the equipment tested.
 - 2) Where the Supplier and OEM are using the type test certificate and type test report beyond that particular equipment that was type tested, to indicate that the other equipment types with their different ratings are covered by the type test certificate and type test report, a separate official signed off letter on the company's letterhead shall be supplied by the Supplier with the tender documentation. This letter shall clearly state all particular tests and the tested parameters that are extrapolated from the type test certificate and type test report.
 - 3) The summary list of type-tests indicating the following:-
 - The type test performed,
 - The IEC standard it was type tested on,
 - The type test report document number;
 - The date of type test performed
 - The Test Facility where the type test was performed, the Test facility accreditation authority.
- b) Generic routine test certificates/reports shall be supplied with the tender documentation (refer to 3.2.23.1) in electronic format (pdf). The test certificate shall indicate (make provision for) the tests performed, results, identification of the equipment tested, etc. The format of the test certificate/report shall make provision for approval by an authorised Eskom representative.

ESKOM COPYRIGHT PROTECTED

- c) One hardcopy of the routine test certificates/reports shall be supplied with each DCB and stored in the documentation pocket inside the operating mechanism enclosure. In addition to the hardcopy, the routine test certificates/reports shall be made available in electronic format and submitted to Eskom

3.3.2 Type and routine test requirements

- a) The manufacturer shall perform a complete set of type tests for each DCB design offered. The type test certificates and reports shall be submitted for review during the tender or product evaluation stage. The type test reports shall be according to SANS 62271-108, and where integral earthing switch is used SANS 62271-102. All type test done on IEC60056 shall not be accepted. If any type testing is carried out during a contract period, Eskom shall be invited as a witness.

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

- b) The DCB shall be type tested in accordance with SANS 62271-108 and specific SANS 62271-102 clauses, which shall include the following tests:
- Dielectric tests insulation level (SANS 62271-108 6.2);
 - Dry lightning impulse withstand voltage test (BIL or LIWL) (SANS 60137 8.3) (for bushings on the dead-tank DCB);
 - Dry power frequency withstand level voltage tests (PFWL) (SANS 62271-108), (SANS 60137 8; 9.3 & 8.1) (for bushings on the dead-tank DCB);
 - Wet power frequency voltage withstand level (PFWL) test (SANS 62271-108), (SANS 60137 8; 9.3 & 8.1) for all bushing < 300kV (for bushings on the dead-tank DCB);
 - Dry switching impulse withstand level voltage test (SIWL) (SANS 62271-108), for bushings rated for $U_r \geq 300\text{kV}$ (SANS 60137 8.4) (for dead-tank DCB);
 - Wet switching impulse withstand test (SIL) for bushings rated for $U_r \geq 300\text{kV}$ (SANS 60137 8.4) (for dead-tank DCB);
 - Radio interference (r.i.v.) tests (SANS 62271-108 6.3)
 - Measurement of resistance of circuit (SANS 62271-108 6.4); temperature rise test (SANS 60137 8.7) (for bushings on the dead-tank DCB);
 - Temperature rise of circuits (SANS 62271-108 6.5); temperature rise test (SANS 60137 8.7) (for bushings on the dead-tank DCB);
 - Short withstand current and peak withstand current tests (SANS 62271-108 6.6);
 - Verification of the protection (IP coding) (SANS 62271-108 6.7) and, in the case of dead-tank Disconnecting circuit-breakers, verification of the protection (IP coding and mechanical impact test) (SANS 62271-203 6.7);
 - Tightness test (SANS 62271-108 6.8 / SANS 62271-203 6.8 (for dead-tank Disconnecting circuit-breakers));
 - Electromagnetic compatibility tests (SANS 62271-108 6.9) - where applicable; (SANS 60137 8.6) (for bushings on the dead-tank DCB);
 - Mechanical and environmental tests (SANS 62271-108 6.101.2.1 - 6.101.2.3);
 - Static terminal load tests (SANS 62271-108 6.101.6);
 - Miscellaneous provisions for making and breaking tests (SANS 62271-108 6.102);
 - Condition after a capacitive current switching test series (SANS 62271-108 6.102.9.4);

- Test circuits for short-circuit making and breaking tests (SANS 62271-108 6.103); verification of thermal short-time withstand current (SANS 60137 8.8) (for bushings on the dead-tank DCB);
 - Short-circuit test quantities (SANS 62271-108 6.104);
 - Short-circuit test procedure (SANS 62271-108 6.105);
 - Basic short-circuit test-duties (SANS 62271-108 6.106);
- Critical current tests (where applicable) (SANS 62271-108 6.107);
- Single-phase and Double earth fault tests (for $U_n \geq 66 \text{ kV}$) (SANS 62271-108 6.108);
- Short-line fault tests (for class S2 Disconnecting circuit-breakers and $U_n \geq 66 \text{ kV}$) (SANS 62271-108 6.109);
- Out-of-phase making and breaking tests (applicable if an out-of-phase rating is assigned) (SANS 62271-108 6.110);
- Capacitive current switching tests (SANS 62271-108 6.111);
- Special requirements for making and breaking tests on class E2 disconnecting circuit-breakers (SANS 62271-108 6.2);
- Tests to verify the proper function of the position indicating device (SANS 62271-108 6.113);
- Tests to verify the proper function of the position indicating device (SANS 62271-108 A.6.105);
- Tests on the power kinematic chain (SANS 62271-108 A.6.105.1);
- Disconnecting circuit-breakers with dependent power operation (SANS 62271-108 A.6.105.1.1);
- Disconnecting circuit-breakers with independent power operation being actuated by the release of latching devices (SANS 62271-108 A.6.105.1.4);
- Test results (SANS 62271-108 A.6.105.3);
- Combined function test (SANS 62271-108 6.114);
- Mechanical operations combined function test (SANS 62271-108 6.114.1);
- Short-circuit combined function test (SANS 62271-108 6.114.2);
- Switching of shunt reactors (for $U_n \geq 66 \text{ kV}$) (SANS 62271-110);
- Electrical endurance tests (for class E2 Disconnecting circuit-breakers) (SANS 62271-310) (for $U_n > 52 \text{ kV}$);
- DCB extended mechanical endurance tests (for class M2 Disconnecting circuit-breakers) (SANS 62271-100 6.101.2.4);
- Cantilever load withstand test (SANS 60137 8.9) (for bushings on dead-tank Disconnecting circuit-breakers);
- Additional tests on auxiliary and control circuits (SANS 62271-100 6.10);
- Proof tests for enclosures (compartment/ metallic tank) (for dead-tank Disconnecting circuit-breakers) (SANS 62271-203 6.103);
- Internal pressure test on gas-filled, gas-insulated and gas-impregnated bushings (SANS 60137 8.11) (for dead-tank DCB);
- Test under conditions of arcing due to an internal fault (for dead-tank Disconnecting circuit-breakers) (SANS 62271-203 6.105);

-
- Insulator tests (for dead-tank Disconnecting circuit-breakers) (SANS 62271-203 6.106);
 - Corrosion test on earthing connections (for dead-tank Disconnecting circuit-breakers) (SANS 62271-203 6.107);
 - All type-tests applicable to CT's (for dead-tank DCB);
 - All type-tests applicable to earthing switches (SANS 62271-102);
- c) Time-current curves of the electrical tripping and closing circuits shall be provided, both for normal operation, and in the event that the tripping/closing plunger is prevented from moving. The resolution of the function times shall be clearly indicated in the test reports.
- d) The DCB shall be routine tested in accordance with SANS 62271-108 and shall include the following tests:-
- Dielectric test on the main circuit (SANS 62271-100 7.1);
 - Dry power frequency withstand voltage tests for bushings (SANS 60137 8 & 9.3) (for dead-tank DCB);
 - Measurement of dielectric dissipation factor ($\tan \delta$) and capacitance at ambient temperature (SANS 60137 8 & 9.1) (for dead-tank DCB);
 - Measurement of partial discharge quantity (SANS 60137 8 & 9.4) (for dead-tank DCB);
 - Tests on auxiliary and control circuits (SANS 62271-100 7.2);

Note: In the case of switchgear supplied from an overseas OEM where the wiring of auxiliary and control circuits is done locally, the tests on auxiliary and control circuits are to be done locally as part of the local factory acceptance testing (refer to 7.1).

- Measurement of the resistance of the main circuit (SANS 62271-100 7.3);
 - Tightness test (SANS 62271-100 7.4 / SANS 62271-203 7.4 (for dead-tank Disconnecting circuit-breakers)); (SANS 60137 9.8) (for bushings of the dead-tank DCB);
 - Design and visual checks (SANS 62271-100 7.5 / SANS 62271-203 (for dead-tank Disconnecting circuit-breakers) / SANS 60137 (for bushings on dead-tank Disconnecting circuit-breakers));
 - Pressure tests of enclosures (for dead-tank Disconnecting circuit-breakers) (SANS 62271-203 7.101); and
 - Internal pressure test on gas-filled, gas-insulated and gas-impregnated bushings (SANS 60137 9.6) (for dead-tank DCB);
 - Mechanical operating tests on DCB (SANS 62271-100 7.101).
 - All factory routine tests applicable to CT's (for dead-tank DCB);
 - All factory routine tests applicable to earthing switches (SANS 62271-102);
- e) The following characteristics, in addition to those specified in SANS 62271-100, shall be measured and recorded during the mechanical operating tests (where applicable):
- Closing and opening speeds;
 - Timing tests on each type of auxiliary switch contact in relation to the main contacts (including relative timing between main and auxiliary contacts of single-pole operated Disconnecting circuit-breakers when operated simultaneously);
 - Settings of pressure switches / gas density monitoring devices; and
 - Time-current curves of the electrical tripping and closing circuits for normal operation. The resolution of the function times shall clearly be indicated on the test reports.

-
- f) Where applicable, Disconnecting circuit-breakers intended for operation with intentionally non-simultaneous poles shall be tested in accordance with SANS 62271-302 (performance verification tests and parameter definition tests for controlled switching applications).
- g) Only for items in which it is requested in the technical schedules, KIPTS (Koeberg Insulation Pollution Test Site) certificates must be supplied for Medium ('c'), Heavy ('d') to Very heavy ('e') site pollution severity (SPS). The KIPTS test facility limitation is currently 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.
 - $U_n > 132\text{kV}$: For insulators for applications with nominal voltages greater than 132kV (i.e. lightning impulse withstand greater than 550kV), the results from the test on 132kV insulator will be extrapolated to longer insulators having the same design in addition to performing the IEC 60507 artificial pollution test.
- h) Where applicable, CTs shall be tested in accordance with SANS 60044-1 or NRS 029, as applicable.
- i) Insulators of the ceramic type shall be tested in accordance with SANS 62155 and SANS 60815-2.
- j) Insulators of the silicone rubber composite type shall be tested in accordance with SANS 61462 and SANS 60815-3.

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

- a) Commissioning checks and a test programme (as determined by the manufacturer) shall be carried out in accordance with SANS 62271-100 10.2.101 and 10.2.102 for all Disconnecting circuit-breakers. The test programme shall be incorporated into the DCB inspection and test plan. This shall include checks after installation, mechanical tests and measurements, checks of certain specific operations and electrical tests and measurements.
- b) Electrical tests shall include, but are not limited to, the following:
- measurement of the steady-state contact resistance (SCRM) of the main circuit; and
 - measurement of the dynamic contact resistance (DCRM or DRM) of the main circuit.
- c) The measurement of the time quantities shall be done at nominal and minimum coil control voltage.

Note: The measured times for nominal and minimum coil control voltage should be within $\pm 5\%$ of the times, as specified on the DCB pass sheet supplied by the OEM.

- d) For each measurement of the operating time, a recording shall be made of each individual operating coil current - namely close, trip I and trip II. The resolution of the function times shall be clearly indicated in the test reports.
- e) During the measurement of the re-charging time of the closing spring, the peak motor current in the spring charging process shall be measured as well as the continuous motor current. Measurements shall be made both at the nominal and minimum control voltage.

Note: The results should be within $\pm 2\%$ of the DCB pass sheet results supplied by the OEM, unless otherwise stated by the OEM and presented with the technical specification test datum sheets.

- f) For the recording of the mechanical travel characteristics, travel curves for each phase shall be recorded. The location of the travel transducers on the Disconnecting circuit-breakers shall be clearly indicated in the test report. The following measuring results shall be provided:
- the total travel (in mm)
 - the over-travel (in mm)

ESKOM COPYRIGHT PROTECTED

- the rebound (in mm)
 - the under-travel (in mm)
 - the contact penetration (in mm)
 - moving-contact or operating rod position at the time of make or break
 - anomalies which are evident from the trace
 - the average speed on closing (in m/s)
 - the average speed on opening (in m/s)
- g) For the measurement of the steady-state contact resistance of the main circuit, a d.c. current of at least 100 A shall be used. The dynamic contact resistance shall be measured during a close and open operation of the DCB. This shall be done for each main contact separately. A detailed diagram of the measurement set-up shall be given (sketched) in the pre-commissioning test report. If any difficulties have occurred during erection or commissioning, this shall be clearly stated in the pre-commissioning test report. The results shall be given in pQ and the resolution shall be at least 1 pQ.
- h) Reasons for differences between the results of the tests made on-site and the results of the tests as they were carried out at the OEM's works (the DCB pass sheet) shall be clearly stated and corrections shall be made.
- i) Where applicable, Disconnecting circuit-breakers intended for operation with intentionally non-simultaneous poles shall be tested in accordance with SANS 62271-302 10.101 (commissioning of Disconnecting circuit-breakers for controlled switching applications)
- j) 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 may be witnessed by Eskom. Refer to 3.4.7.2 for further information on the pre-commissioning test report.

3.4 Manufacturing, transport, storage, installation, pre-commissioning and after sales technical support

3.4.1 General

- a) The manufacturing, transport, storage, installation and pre-commissioning of switchgear and controlgear, as well as their operation and maintenance in service, shall be carried out in accordance with the instructions given by the OEM.
- 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 (refer to 3.2.23.1).

3.4.2 Inspection of manufacturing facilities and Disconnecting circuit-breakers

- a) Eskom reserves the right to inspect and evaluate all manufacturing and testing facilities relating to the Disconnecting circuit-breakers offered - both before and at any time during manufacturing.
- b) Eskom reserves the right to inspect any ordered DCB 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 (refer to 3.2.23.1), the supplier shall submit the quality control plans (QCP) and quality inspection plans (QITP) 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.

ESKOM COPYRIGHT PROTECTED

Note: Where applicable, the minimum required notification period for overseas travel from South Africa is 8 weeks.

- d) Any deviations in the DCB design shall be pointed out by the Supplier in accordance with the deviation schedule submitted with the tender documentation, 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.
- f) The inspected and evaluated factory manufacturing the DCB for Eskom shall maintained by the Supplier. If there are changes to relocate manufacturing factory, Eskom shall be notified and the contractual concession procedure followed. The DCB manufactured from a factory that was not evaluated and approved by Eskom shall not be acceptable to Eskom or via third parties building the Eskom asset.

3.4.3 Conditions during transportation

Note: Refer to DST_240-53902499, for the requirements on transport, handling, storage and preservation.

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

3.4.4 Transportation and off-loading

- a) Refer to 3.2.23.4 for the requirements for packaging for transportation and storage.
- b) The Supplier shall be responsible for the transportation and off-loading of the equipment on site. Off-loading includes transportation from the point of off-loading the equipment after transportation to the point of installation.
- c) The Supplier shall provide his own means of off-loading at the point of installation.

3.4.5 Storage and preservation

- 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 (refer to 3.2.23.1) as well as with orders upon awarding of a contract.
- 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.

ESKOM COPYRIGHT PROTECTED

-
- c) Where heaters need to be energised, a clearly marked electrical connection point (refer to k)) shall be provided to enable Eskom to supply power to the heaters.
 - d) The Supplier shall implement proper storage and handling (de-stuffing) procedures, which should always be part of site delivery documentation. A copy of the storage and handling procedures shall be made available to Eskom for acceptance (refer to 3.2.23.1). This shall indicate the maximum recommended period of storage, as well as recommended actions to be taken if a longer storage period (preservation) is required.
 - e) The Supplier shall provide the storage and preservation protocol from the OEM with the tender documentation for Eskom evaluation, namely site requirements, spares requirement and stores facility requirement.

3.4.6 Installation

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

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

- b) Installation includes mounting and securing the equipment and its support structure onto the concrete support foundation, leveling of the switchgear, filling of gas (other insulation and/or extinguishing medium), where applicable.
- c) For each type of DCB, the installation instructions provided by the supplier (refer to 3.2.23.1) according to the OEM's instructions shall at least include the items listed below:
 - unpacking and lifting instructions: all information required for unpacking and lifting safely shall be given, including details of any special lifting and positioning devices that are necessary;
 - assembly: when the switchgear is not fully assembled for transport, all transport units shall be clearly marked. Drawings showing the assembly of these parts shall be provided with the switchgear;
 - mounting: instructions for mounting the common base frame, poles, operating device(s) and auxiliary equipment shall include sufficient details to enable site preparation to be completed. These instructions shall also indicate:
 - 1) the total mass of the equipment, inclusive of insulation and/or extinguishing medium;
 - 2) the mass of insulation and/or extinguishing medium; and
 - 3) the mass of the heaviest part of the apparatus to be lifted separately if it exceeds 100 kg;
 - qualification of personnel: all personnel employed by the Supplier who are involved in the installation and pre-commissioning of the DCB 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
 - final installation inspection and testing: instructions shall be provided for inspection and testing after the switchgear and controlgear has been installed and all the interfacing connections have been completed. These instructions shall include the following:
 - 1) procedures for carrying out any adjustment that may be necessary to achieve correct operation;
 - 2) recommendations for any relevant measurements that should be made and recorded to help with future maintenance decisions; and
 - 3) instructions for final inspection and testing.

ESKOM COPYRIGHT PROTECTED

- d) The Supplier shall be responsible for ensuring the training and accreditation of persons employed for the installation and pre-commissioning of switchgear.
- e) During the performance of the work at the substation site, the Supplier shall comply with all the relevant statutes, regulations, bylaws and codes, as well as all the safety and quality requirements pertaining to the work. The Supplier shall provide all apparatus including safeguards and personal protective equipment (PPE), including a Fall Arrest System (FAS), necessary for the performance of the work.
- f) Installation tools / equipment and debris shall be removed from site when installation is completed.
- g) Where a.c. power supplies cannot be made available to the Supplier for installation and pre commissioning purposes, the Supplier shall be responsible for providing his own a.c. power supply (e.g. generator) for the installation and pre-commissioning of switchgear.

3.4.7 Pre-commissioning

3.4.7.1 Testing of each DCB after installation

Each DCB shall be tested after installation in accordance with 3.3.3. This is to assure proper installation and that no damage occurred during transportation. The pre-commissioning tests shall be witnessed by an appointed Eskom representative/official, and this step shall be part of the Hold Point on the QITP to be signed by all parties.

To facilitate the testing, adequate d.c. power supplies, test equipment and suitably qualified and accredited personnel shall be provided by the Supplier.

For reasons of compatibility with Eskom's on-site test equipment and test records, one of the following types of equipment shall be used by the Supplier to measure/record the time quantities and travel characteristics:-

- a) Elcon - S A10 Instrument, Sweden;
- b) Programma Elektrik AB - TM 1600 or TM 1800 Instrument, Sweden;
- c) KoCoS ACTAS (subject to specific DCB design that cannot be tested using the above).

Note: 1) The software used shall be compatible with any one of the above instruments, and will be specified by the Supplier when Eskom places the order of the DCB. The choice may depend on where the DCB will be used.

Eskom shall not approve any other equipment or test results for site testing except the above list of test equipment.

The test results shall be in clear and readable format. These shall be in English language.

3.4.7.2 Pre-commissioning test report

The DCB pre-commissioning test report shall be submitted to Eskom, comprising the following parts:

3.4.7.2.1 Required measurements records

- a) After the measurements at the substation site, a hand-written pre-commissioning test report shall be handed over to the appointed Eskom representative/official. Any special note that is on the OEM instruction manual and/or test protocol shall be incorporated by the Supplier on this report, e.g. "Activate anti-condensation heaters";
- b) Within three weeks after the pre-commissioning tests, the Supplier shall submit an official report to Eskom (two hardcopies); and
- c) An electronic copy of the official report shall be provided on a CD for each individual DCB. The software used shall be compatible with one of the types of test equipment mentioned above. Reports shall be in .pdf or Microsoft Word (.doc) format.

3.4.7.2.2 Measured values

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

ESKOM COPYRIGHT PROTECTED

- a) Test/measuring equipment information/data:
- make and type of instruments;
 - serial numbers of instruments;
 - methods of triggering;
 - measuring methods;
 - the accuracy of the instruments; and
 - calibration certificates of the measuring instruments used;
- b) The DCB data:
- make and type;
 - serial numbers of poles and operating mechanisms;
 - rated voltage, normal current and short-circuit breaking current;
 - the name of the substation and section;
 - DCB identification and application;
 - date of commissioning; and
 - date and time of testing/measuring.

3.4.7.2.3 Clear copies attached to the official report

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

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

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

3.4.7.4 Final inspection to hand-over

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

3.4.8 Safety related data (where applicable)

All liquids or chemicals used during installation shall be supplied with Material Safety Data Sheets (MSDS).

3.4.9 Requirements for pressure vessels (where applicable)

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

3.4.10 After sales technical support

The Supplier shall provide locally based technical specialist support on a full time basis for the duration of the contract.

3.5 Inspection and maintenance

3.5.1 General

The effectiveness of maintenance depends mainly on the way instructions are prepared by the OEM and implemented by Eskom. The Supplier shall supply maintenance information in the form of maintenance manuals, full maintenance analysis FMECA as per Annex D, OEM test plan/ speed calculation datum points (for closing and opening DCB operation) field service bulletins and Digital Video Disk (DVD) material covering the following aspects:

a) Extent and frequency of maintenance:

For this purpose, the following factors shall be considered:

- 1) switching operations (accumulated switching amperage);
- 2) total number of operations (a graph showing the maximum number of guaranteed operations as a function of short-circuit breaking current shall be provided as well as the maintenance and time required to restore the DCB once the accumulated switching amperage limit has been reached);
- 3) environmental conditions;
- 4) measurement and diagnostic tests for condition monitoring;
- 5) full maintenance analysis FMECA as per Annex D; and
- 6) storage requirements and maintenance inspections.

b) Scope of work to be performed:

It shall include the following:

- 1) recommended place for the maintenance work (indoor, outdoor, in factory, on-site, etc.);
- 2) procedures for inspection, diagnostic tests, examination overhaul;
- 3) reference to drawings;
- 4) reference to part numbers or standard kit of parts;
- 5) tools required, including special equipment or tools;
- 6) precautions to be observed (e.g. cleanliness and possible effects of harmful arcing by-products);
- 7) lubrication procedures; and
- 8) cleaning materials.

c) Graphical information:

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

d) Specified operational values:

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

- 1) pressure levels (where applicable);

ESKOM COPYRIGHT PROTECTED

- 2) operating times and contact velocities;
- 3) resistance of the main current carrying circuits;
- 4) insulation and/or extinguishing medium characteristics (e.g. the SF6 purity, dew point, acidity, etc.);
- 5) quantities and quality of gas;
- 6) condition of the method used for voltage distribution across multiple interrupter units;
- 7) contact condition (including contact dimensions);
- 8) torque settings for fasteners; and
- 9) important dimensions.
- e) Specifications for materials:
This includes warnings of known non-compatibility of materials.
 - 1) fluid; and
 - 2) cleaning and degreasing agents.
- f) Tools, lifting and access equipment:
A list of standard and specialised tools shall be provided with description of their application and associated part number.
Tests after the maintenance work: All tests shall be clearly described and shall include the parameters to be observed.
- g) Spare parts:
Description, reference number, quantities and storage requirements.
- h) Time estimates:
Estimated time required to carry out maintenance activities.
- i) Detailed information:
This relates to the recommended makes and types of transducers (linear or rotary) to facilitate the measurement of travel curves. Such transducers (as well as the brackets, fittings and so forth that are needed to apply them on the DCB) are part of the special maintenance tools for the DCB. The manual shall show clearly how the transducer, together with any brackets, fittings, etc, shall be mounted and applied on the DCB.

3.5.2 Maintenance DVD

It is anticipated that maintenance intervals for the Disconnecting circuit-breakers 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 (refer to 3.2.23.1). 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.

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 (with some general knowledge of the equipment) 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.

The DVD shall cover routine inspection, minor and major maintenance (overhaul) 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.

These sections may be on separate DVD's 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 disassembly steps, including any marking of positions required prior to disassembly, any discharging of pressure and/or stored energy;
- the disassembly, removal, replacement and re-assembly of any sub-components requiring scheduled maintenance/replacement;
- the re-assembly, realignment and re-installation of all components, including any lubrication of moving parts;
- a brief summary of the evacuation, refilling and leak testing of the re-assembled equipment;
- the testing of the re-assembled equipment, including acceptable values and tolerances of the measured/tested parameters; and
- some trouble-shooting methods if the required tolerances are not achieved.

The trouble-shooting portion of the 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.

3.5.3 Spares

3.5.3.1 General

Spares will normally be purchased at the same time that orders are placed for Disconnecting circuit-breakers. The Supplier shall provide a list of the minimum recommended spares (refer to e)) together with prices in the pricing schedules for the Disconnecting circuit-breakers concerned.

Note: Delivery to any of the specified destinations should remain valid for the duration of the contract period and be subject to the same Contract Price Adjustment formula as applied to the Disconnecting circuit-breakers.

3.5.3.2 Availability of spares

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

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

The following spares shall be readily available locally (in South Africa) within 12 hours:

- trip coils;
- close coils;
- spring charging motors;

ESKOM COPYRIGHT PROTECTED

-
- SF6 density monitoring devices (If applicable, other insulation and/or extinguishing medium); and
 - contactors and relays.

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

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

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

This information shall be supplied to Eskom in a legible and acceptable format in English when notice of discontinuation of the DCB 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 his/her spares availability philosophy with the tender documentation (refer to 3.2.23.1).

3.5.3.3 Identification of spares

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.

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

3.5.3.4 Packaging, preservation and storage of spares

Refer to QM-58 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.

3.5.3.5 D.C. supply voltage conversion kits

D.C. supply voltage "conversion kits" shall be kept locally by the Supplier in South Africa for the duration of the contract to ensure that they are readily available as and when required. Separate conversion kits shall be available that are able to convert from 110 V d.c. to 220 V d.c. or from 220 V d.c. to 110 V d.c. Refer to a).

3.5.4 Modifications to Disconnecting circuit-breakers during their service life

If, during the normal service life of a DCB supplied, Eskom requires to be notified about a necessary modification, a field service bulletin shall be issued to the Eskom contract manager and relevant technical specialists giving details of the modification and the reason for it. Suitable training and parts shall be supplied to Eskom within 30 days of any modification required for all Disconnecting circuit-breakers supplied to Eskom. All concessions shall be approved by Eskom.

Note: During the period covered by a particular contract or product acceptance cycle, the Supplier shall not make any changes to the equipment or materials without receiving approval from Eskom. All concessions shall be approved by Eskom. No changes will be permitted to the mounting details of the equipment or in other points of interfacing with Eskom standard structures. If the Supplier decides to make any changes to the agreed-upon design of the DCB, then the change(s), together with the reasons for making the change(s), shall be forwarded to the Eskom contract manager and relevant technical specialists in writing for approval (also refer to QM-58 specification).

3.5.5 Condition monitoring of Disconnecting circuit-breakers

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

- accumulated interruption amperage values (per pole);
- contact wear (per pole);
- continuous measurement of SF6 gas or other insulation and/or extinguishing medium density, the instrumentation for which will provide information enabling early warning of insulation and/or extinguishing medium leaks and planned outages for refilling or repairs;
- analyser for SF6 gas quality and decomposition products (with alarms); and
- continuous monitoring, recording and alarm signalling of the mechanical operating characteristics of the DCB.

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

All information required to carry out condition monitoring of Disconnecting circuit-breakers (including, but not limited to, specification sheets, speed calculation points, travel curve values, etc.) shall be provided by the Supplier and OEM for each type of DCB. This information shall be given to the Eskom contract manager and relevant technical specialist upon awarding of the contract.

3.5.6 Technical non-conformance on the DCB during its service life

All non-conformances (NCR's) raised by Eskom which are found to be the deviation from type-tested parameters shall be addressed by the Supplier and the Manufacturer during the DCB service life. These NCR's shall be based on the technical documentation submitted by the Supplier and in accordance with the SANS related standard.

3.6 Manuals

3.6.1 General

Transport, storage, installation (erection), operation and maintenance information shall be submitted in the form of manuals (refer to 3.2.23.1 and 3.2.23.2) with the tender documentation. These manuals shall be in English and provided in the following formats:

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

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.

3.6.2 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 DCB 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, photos and description shall be easily read together;
- routine inspection, minor and major maintenance procedures shall be given together with a list of lubricants, recommended spares and/or special tools and so on, required for these activities;
- it shall contain high-quality diagrams and photos showing details of operating components of the DCB, 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, compounds and so on shall be listed.

One set of sample manuals shall be supplied to Eskom with the tender documentation (refer to 3.2.23.1) for approval. After approval, the requisite number of manuals shall be supplied.

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):

General

- title page: title of equipment, equipment ratings, contract and order numbers, Supplier's reference numbers. This information shall also appear on the outside of the binder and on the first page;
- table of contents: the 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 DCB operation;
- full details of method adopted for anti-pumping;
- as per SANS 622710-108, the details of interlocking between the disconnect open position, and where applicable between phases;
- where applicable, details of auto-reclosing arrangements;
- schematic wiring diagram of DCB; and
- where applicable, full details of all valves, including information regarding materials of valves and valve seats. If materials such as synthetic rubber or other equivalent types are used, the method of bonding or clamping these materials shall be given.

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.

ESKOM COPYRIGHT PROTECTED

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, gas-filling and monitoring procedures;
- the levels of expertise required for the construction team;
- a man-hour estimate for the installation work required on site;
- a list of special equipment and tools required for unloading and positioning components of the DCB 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.

Testing

- functional testing, dielectric testing, controlled switching 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.

Inspection and maintenance

- the maintenance manual shall contain the typical contents as described in 3.5.

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;
- procedures for the safe disposal of decomposed SF6 gas products shall be described; and
- trouble-shooting procedures shall be provided.

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.

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 3.2.23.

ESKOM COPYRIGHT PROTECTED

3.7 Training

The Supplier shall provide first-hand training of an international standard on the supplied equipment by OEM accredited instructors for the duration of the contract.

Refer to 240-56065202 for the switchgear training requirements from original equipment manufacturers. The supplier shall provide with the tender documentations, the detailed training programme in accordance with this training standard 240-56065202.

3.8 Safety, health, environment and quality

Refer to 240-56063765 for Eskom's health and safety management requirements for Suppliers. Refer to QM-58 for Eskom's quality management requirements for Suppliers.

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

4. Authorisation

This document has been seen and accepted by:

Name and surname	Designation
Bheki Ntshangase	Senior Manager PDE HV Plant and Plant Equipment SC Chairperson
Jabulani Cebekhulu	AIS Care Group Convener
Andre Marais	HV/ EHV GIS/ MTS Care Group Convener
Andre Huisamen	Transmission Switchgear Task Team Convener
Ajith Persadh	Distribution Switchgear Care Group Convener
Quinten Nepgen	GIS Work Group Convener
Naresh Rampersad	Transmission HV Plant Manager's Forum – Switchgear representative
Monde Bala	Senior Manager OU - Maintenance and Operation & Distribution Plant Management Forum representative

5. Revisions

Date	Rev	Compiler	Remarks
July 2016	1	S. Nkosi	DCB standard drawn from the SANS 62271-108 and the Eskom CB standard 240-56063756 Rev 6 dated September 2015

6. Development team

The following people were involved in the development of the circuit-breaker standard.

- Sphiwe Nkosi Technology PDE HV Plant
- Jabulani Cebekhulu Technology PDE HV Plant
- Isaac Sibeko Technology PDE HV Plant
- Almund Cilliers Dx Mpumalanga OU
- John Orton Dx Mpumalanga OU
- Len Ludik Tx (Southern Grid)

ESKOM COPYRIGHT PROTECTED

- Grant Ruiters Tx (Northern Cape Grid)
- Sarel Pretorius Tx (Central Grid)
- Fanie Botha Tx (Free State Grid)
- Bernie Murfin QA CED 765kV Projects
- Johan D Fourie Tx (Northern Grid)
- Tjaart van der Berg Tx (Northern Grid)

7. Acknowledgements

The Compiler acknowledges the contributions to this revision from the members of the DCB Joint Working Group, Technology, Distribution, Transmission and all who improved this document with the valuable comments received.

Annex A – Supplier and Eskom responsibilities

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

A.1 Supplier's responsibilities

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

- a) upon submission of a tender, the submission of a complete set of technical documents as required by this standard (refer to clause 3.2.23 for documentation requirements and Table A1), this shall be in paper print, Adobe PDF copy and all the technical schedules A and B shall also be submitted in a copy of the Microsoft Excel format. The Technical Compliance Clause by Clause of the technical specification shall be compiled by the Supplier. The Supplier shall ensure that the tender states clearly all deviations (if any) in the Deviation Schedule and in Schedule B (if applicable). Deviations will be evaluated by Eskom and the outcome will be communicated, in writing, to the Supplier/ Tenderer;
 - 1) The Supplier shall also read the Technical Evaluation Criteria standard 240-46425564 with this document and supply all the information with the technical submission in order for the technical documentation to be evaluated by Eskom. Failing to provide information called by this standard and the Technical Evaluation Criteria standard 240-46425564 shall render the technical submission disqualified for technical evaluation. The minimum requirements (the Returnables by the Supplier/ Tenderer) for Eskom to perform the technical evaluation shall be as listed under A.1.1) and A.1.1.1, which shall be used in combination with the Technical Evaluation Criteria 240-46425564.

A.1.1) Eskom requirements for technical evaluation

Below are minimum requirements for technical evaluation (the Returnables by the Supplier/ Tenderer) which Eskom requires for the technical evaluators to start with the technical evaluation of the submission.

A.1.1.1) Minimum requirements for technical evaluation

The following Table A.1 contains the list of the minimum documentation that shall be provided by the Supplier/ Tenderer as Returnables which shall be used to perform the technical evaluation. The Supplier shall populate this Tick-sheet 4th column below with the details of the Tender Returnables submitted:-

Table A.13: The Returnables Tick-sheet to be completed by each Supplier/ Tenderer

Item	Clause of DCB spec 240-105506460	Minimum requirements for technical evaluation	Supplier to indicate submitted returnables
A.1.1		The Mandatory requirements for technical acceptance. NOTE: If the following are not met, the submission shall be disqualified for further technical evaluation.	
	3.1.1 – 3.1.19; 3.3.2;	<ul style="list-style-type: none"> • Live-tank DCB or Dear-tank DCB type (select applicable type) i. Rated characteristics (Refer to Annexure A: In accordance with DCB spec clauses, Technical A & B schedules and SANS/ IEC 62271-108 Clause 6) ii. Type tests (Refer to SANS/ IEC 62271-108 Clause 6) 	

ESKOM COPYRIGHT PROTECTED

	3.7	iii. Training offered	
A.1.2		The completed Technical A&B schedules of the DCB and Optional digital secondary plant interface. All the completed Technical A&B schedules shall be submitted in the following 3 formats:-	
		<ul style="list-style-type: none"> Paper printed, 	
		<ul style="list-style-type: none"> Adobe PDF 	
		<ul style="list-style-type: none"> The original electronic format it was issued by Eskom, namely Microsoft Excel format or MS Word format 	
A.1.3	3.2.23.1	The completed Sheet – “Technical Deviations schedule”	
A.1.4	A.1	Compliance Clause by clause (i.e. the comments or response to each clause on the DCB Technical Specification and highlighting areas that the product deviates on)	
A.1.5	3.3.1.2; 3.2.23.1	<p>The summary list of type-tests indicating the following:-</p> <ul style="list-style-type: none"> i. Type test performed, ii. The IEC standard it was tested on, iii. The type test report document number; iv. The date of type test performed; v. The Test Facility where the type test was performed, the Test facility accreditation authority 	
A.1.6	3.3.1.2; 3.2.23.1	The copies of the type- test reports and/ or type test certificates	
A.1.7	3.3.1	Confirm of the manufacturer's capabilities to be responsible to perform test or having performed, and if any limitations exist	
A.1.8	3.3.1.2	Generic routine test certificates/reports	
A.1.9	3.2.23.1	The detailed list of references where the same switchgear type is installed	
A.1.10	3.2.5; 3.2.7 & 3.2.23.1	The general arrangement outline drawing for each offered item	
A.1.11	3.2.20; 3.2.20.1 & 3.2.23.1	Electrical secondary wiring schematics (NOTE: This shall include the wiring schematics of the offered controlled switching device, condition monitoring device and Optional digital interface)	
A.1.12	3.6 & 3.2.23.1	Manuals submitted – Transport, storage, installation, operating and maintenance (Manuals submitted in both hardcopy & Electronic copy and in written in English.)	
A.1.13	3.7	Training details in accordance with the Spec clause 3.7 and 240-56065202, “Switchgear Training Requirements from Original Equipment Manufacturers Standard”	

A.1.14	3.2.23.1 & 3.5.2	The written commitment to provide maintenance DVD	
A.1.15	3.2.6 & Table 6	Material and Corrosion Protection Information. Also the lubricants that are exposed to air, SF6 gas and its arcing products	
A.1.16	3.2.6	The details of measures taken to prevent flange corrosion - drawings of the flange arrangements, treatments, maintenance frequency and service experience	
A.1.17	3.2.22; 3.3.1.2; 3.5.3 & 3.2.23.1; sheet on Tech A&B schedule	The completed sheet for offered DCB – “Tools, Spares, Drawings and Type Test reports/ certificates Schedule for...”	
A.1.18	3.5.3.2	Supplier shall state his/her spares availability philosophy	
A.1.19	sheet on Tech A&B schedule	(where applicable) The completed sheet – “Controlled switching device - Point on Wave (POW) relay...”	
A.1.20	3.2.14 & 3.2.18	Full details of the controlled switching system offered; The electronic controller technical details (IEC61850 protocol compliant); Mechanical characteristics; Dielectric characteristics as function of measured characteristics	
A.1.21	3.2.24; 3.4.5; 3.5.3.4	Supplier shall provide the storage and preservation protocol from the OEM	
A.1.22	3.1.2	Proof of insulation testing upon during service - loss of SF6 pressure, contamination of SF6 gas caused by wear and arcing by-products, both wet and polluted conditions	
A.1.23	3.2.2	The detailed Factory Failure Rate (FFR) percentage over the period of 5 years.	
A.1.24	3.2.2	Information on On Time Delivery (OTD) percentage over the period of 5 years.	
A.1.25	3.2.2	Technical response to Non-Conformance (NCR's) percentage over a period of 1 year	
A.1.26	Annex D	Full maintenance analysis FMECA of the DCB unit	
A.1.27	3.2.2.1; 3.2.13 & 3.2.23.1	Detailed information on how CT's are accessed for primary injection testing and CT replacement; Details of magnetizing curves (on a log-scale)	
A.1.28	3.2.2.1 & 3.2.23.1	Premature failures experienced in service of similar design Disconnecting circuit-breakers supplied elsewhere by the manufacturer	

A.1.29	3.2.2.2	Details of the interlocking device	
A.1.30	3.2.8.1	The method for securing of position and padlocking facility	
A.1.31	3.2.2.3 & 3.2.4	Operating mechanism enclosure padlocking details	
A.1.32	3.2.2.4	The details of the maintenance outage disconnecting device facility and special tools list	
A.1.33	3.2.4	Details of special equipment required to view indications and reading when servicing is to be performed above ground level	
A.1.34	3.2.4	The proposal to prevent visual exposure of earthing when using copper or aluminium	
A.1.35	3.2.5 & Table 5	The details of the steel support structure and requirement for the concrete foundation	
A.1.36	3.2.8	The details of pressure relief devices offered	
A.1.37	3.2.12	The details of the offered Non-return valves arrangements on the DN8 / DN20 fittings and pipe-work	
A.1.38	3.2.12	Complete details of all insulation and/or extinguishing medium pressure devices, including drawings, manufacturer's specifications, performance and test data, details of production tests and a quality control programme	
A.1.39	3.2.14	The method for switching surge control (where applicable)	
A.1.40	3.2.15	Where two or more series interrupters are used - How to verify the condition of the method for voltage distribution during the life of the DCB	
A.1.41	3.2.16 & 3.1.9	Details of DCB to interrupt short-circuit currents with a higher degree of asymmetry than required by the SANS 62271-100 standard (1.15pu)	
A.1.42	3.2.19	The timing events (with tolerances) in order to correctly set the PD timer	
A.1.43	3.2.20.1 & Annex C.	Response to the Digital secondary plant interface option; Complete the Schedules A&B of Eskom Standard 240-6465228	
A.1.44	3.4.2 & 3.2.23.1	The quality control plans (QCP) and quality inspection plans (QITP)	

- b) all testing and recording of results required by this standard as well as the OEM's own protocols using accredited personnel including the use of approved and calibrated test equipment. Type testing shall be carried out in accordance with the relevant IEC product standards. All testing shall be done at accredited local test facilities (SANAS accredited – e.g. SABS) or accredited international testing authorities (e.g. KEMA/CESI/IPH);

-
- c) in the case of evaluation at the factory of Disconnecting circuit-breakers 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;
 - d) ensuring equipment is in an acceptable and safe working condition during all phases of transportation from factory to site, storage until the point of official handing over;
 - e) all necessary arrangements for factory acceptance, transporting and off-loading at the most convenient point (if applicable), as well as for transporting and off-loading at the ultimate destination. Eskom will only accept delivery to the destination specified at the time of placing the order – unless otherwise negotiated. Shafts, bearings and machined surfaces exposed during transport and storage shall be treated with a temporary anti-corrosive coating;
 - f) provision of OEM accredited installation and pre-commissioning services for all on-site work;
 - g) the supply of all documentation relevant to the DCB including routine factory test results. Records shall be available during the pre-commissioning (on-site) testing phase;
 - h) when required, the supply of a fully complete DCB assembled, installed, pre-commission (on-site) tested and ready for handover (including, where applicable, controlled switching systems);
 - i) where necessary (i.e. in the absence of an on-site a.c. power supply), the supply of an a.c. power supply (e.g. generator) for the installation and pre-commissioning of switchgear;
 - j) the supply of all conductor clamp main terminals on the supply and load side;
 - k) the supply of all necessary auxiliary equipment, including operating mechanisms, control, monitoring and protective devices, installed in suitable operating mechanism enclosures;
 - l) the supply of all auxiliary and control wiring and terminations for the DCB, including inter-pole cabling and cabling to the central control enclosure(s). For single-pole operated Disconnecting circuit-breakers the wiring shall be done in the factory. No additional inter-pole wiring on site is allowed;
 - m) the supply of all electrical and mechanical interconnections between the elements of the DCB – made to Eskom's satisfaction;
 - n) the supply of all fixing bolts, fasteners and adapter plates – excluding the bolts required for fixing support structures to concrete foundations (which are to be supplied by Eskom);
 - o) where applicable, the first filling of the insulation and/or extinguishing medium to the OEM's rated value;
 - p) when required, the supply of the steel support structures for the DCB;
 - q) when required, testing and recording of results required by this standard as well as the OEM's own protocols using accredited personnel including the use of approved and calibrated tools and test equipment;
 - r) provision of all training in accordance with 240-56065202 by OEM accredited trainers;
 - s) any modifications required during the DCB service life; and
 - t) any other responsibilities as specified in this document.

A.2 Eskom's responsibilities

Eskom shall be responsible for the following:

- a) the supply of the relevant standard(s) or specification(s) and completed schedule A's with the enquiry;
- b) the evaluation of all equipment offered and documentation supplied with a tender. This includes the compilation of an evaluation report summarising the outcomes of the evaluation;
- c) when required, the assessment and evaluation of the relevant manufacturing facilities;

ESKOM COPYRIGHT PROTECTED

- d) when required, the assessment and evaluation of the relevant transport, installation and pre-commissioning facilities;
- e) the approval of all drawings submitted by the Supplier (e.g. general arrangement, nameplate, schematic wiring, etc.);
- f) the approval of all other documentation provided by the Supplier (e.g. manuals, training material, inspection and testing plans after installation, etc.);
- g) the supply of a heater connection point for long term storage;
- h) the provision of concrete foundations for the approved DCB support structure;
- i) the stringing and clamping of main conductors;
- j) the supply and installation of the control cabling to the DCB operating mechanism enclosure;
- k) the supply and installation of all control, metering, relaying and annunciation equipment remote from the DCB;
- l) specifying (at the time of placing the order) whether the steel support structure for the DCB is required to be supplied by the Supplier;
- m) if necessary, provide suitable storage facilities where Disconnecting circuit-breakers are to be stored for extended durations prior to installation due to unplanned delays; and
- n) the witnessing and approval of the first complete DCB installation and pre-commissioning.

**Annex B – Technical Schedule A & B (Generic) – DO NOT POPULATE THIS
TECHNICAL SCHEDULES A & B FOR
OUTDOOR DISCONNECTING CIRCUIT-BREAKERS (DCB's) FOR SYSTEM
NOMINAL VOLTAGES 66KV AND ABOVE**

SAP: _____ DCB 132kV 3150A 40kA 3P 31 220VDC

Schedule A: Purchasers specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

1	2	3	4	5
Item	Claus e of 240- 10550 6460	Description	Schedule A	Schedule B
1		Item and system description		
		DCB 132kV 3150A 40kA 3P 31 220VDC		
1.1		• SAP No	_____	xxxxxxxxxx
1.2		• Buyers Guide Drawing	_____	xxxxxxxxxx
1.3		• DCB application	Bypass current limiting reactor - Operated normally in Open position	xxxxxxxxxx
1.4		• Nominal system voltage (U_n) kV	132	xxxxxxxxxx
1.5		• System voltage range pu	0,9 to 1,1	xxxxxxxxxx
1.6		• System earthing (effective/non effective)	Non-effective	xxxxxxxxxx
		<input type="checkbox"/>		
2		Ratings		
2.1		• Rated voltage (U_r) kV	145	
2.2		• Number of phases on system	3	
2.3		• Rated short-duration power-frequency withstand voltage (U_d) - Phase-to-earth and between phases kV	275	
2.4		<input type="checkbox"/> Rated short-duration power-frequency withstand voltage (U_d) - Phase-to-earth and between phases - (under Wet conditions as per SANS 62271-1 cl. 6.2) kV	xxxxxxxxxx	
2.5		<input type="checkbox"/> Rated short-duration power-frequency withstand voltage (U_d) - Across open switching device (under Dry conditions) kV	315	
2.6		<input type="checkbox"/> Rated short-duration power-frequency withstand voltage (U_d) - under Wet conditions as per SANS 62271-1 cl. 6.2 kV	xxxxxxxxxx	
2.7		• Rated peak lightning impulse withstand voltage (U_p) - Phase-to-earth and between phases kV	650	
2.8		<input type="checkbox"/> Rated peak lightning impulse withstand voltage (U_p) - Across open switching device kV	750	

ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **76 of 107**

2.9	<input type="checkbox"/>	Rated switching impulse withstand voltage (U_s) - (Dry conditions)	kV	N/A	
2.10	<input type="checkbox"/>	Rated switching impulse withstand voltage (U_s) - under Wet conditions as per SANS 62271-1 cl. 6.2	kV	N/A	
2.11	•	Rated frequency (f_r)	Hz	50	
2.12	•	Rated normal current (I_r) - main circuit	A	3150	
2.13	•	Calculated maximum continuous current - main circuit @ 40 °C ambient	A	xxxxxxxxxx	
2.14	•	Calculated maximum continuous current - main circuit @ 45 °C ambient	A	xxxxxxxxxx	
2.15	•	Maximum allowable temperature of main contacts (refer to Table 3 of SANS 62271-1)	°C	xxxxxxxxxx	
2.16	•	Measured temperature rise (highest) of main contacts @ rated current (type test)	K	xxxxxxxxxx	
2.17	•	Maximum allowable temperature of bolted or equivalent connections (refer to Table 3 of SANS 62271-1)	°C	xxxxxxxxxx	
2.18	•	Measured temperature rise (highest) of bolted or equivalent connections @ rated current (type test)	K	xxxxxxxxxx	
2.19	•	Maximum allowable temperature of terminals for the connection to external conductors (refer to Table 3 of SANS 62271-1)	°C	xxxxxxxxxx	
2.20	•	Measured temperature rise (highest) of terminals for the connection to external conductors @ rated current (type test)	K	xxxxxxxxxx	
2.21	•	Rated short-time withstand current (I_k and I_{ke})	kA	40	
2.22	•	Rated peak withstand current (I_p and I_{pe})	kA	100	
2.23	•	Rated duration of short circuit (t_k)	s	3	
2.24	•	Rated d.c. supply voltage of closing and opening devices and of auxiliary and control circuits (U_a)	V	220	
2.25	•	Rated a.c. supply voltage of heaters and other a.c. auxiliary circuits (U_a)	V	230	
2.26	•	Rated supply frequency of closing and opening devices and of auxiliary and control circuits	Hz	d.c.	
2.27	•	Rated supply frequency of heaters and other a.c. auxiliary circuits	Hz	50	
2.28	•	Rated short-circuit breaking current (I_{sc}) of DCB	kA	40	
2.29	•	Factor by which the 100 % symmetrical and asymmetrical single-phase rated short-circuit breaking current exceeds the three-phase rating	pu	xxxxxxxxxx	
2.30	•	DCB class		xxxxxxxxxx	
2.31	•	First-pole-to-clear factor (k_{pp}) for DCB		1,5	
2.32	•	Standard values of TRV related to the rated short-circuit breaking current (SANS 62271-		SANS 62271-100 Table 4	

ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **77 of 107**

		100)		
2.33		• Rated short-circuit making current of DCB	kA	100
2.34		• Rated operating sequence for DCB		O-0,3s-CO-3m-CO (all poles)
2.35		• Minimum resting time following rated operating sequence	min	xxxxxxxxxx
2.36		• Characteristics for short-line faults		SANS 62271-100 4.105 for Class S2 circuit-breakers only
2.37		• Rated out-of-phase making and breaking current for disconnecting circuit-breakers	kA	xxxxxxxxxx
2.38		• Classification of DCB according to its restrike performance (line- and cable-charging breaking current)		Class C2
2.39		• Rated capacitive switching currents for DCB - line-charging breaking current	A	50
2.40		• Rated capacitive switching currents for DCB - cable-charging breaking current	A	160
2.41		• Classification of DCB according to its restrike performance (capacitor bank switching)		xxxxxxxxxx
2.42		• Rated capacitive switching currents for DCB - single capacitor bank breaking current	A	xxxxxxxxxx
2.43		• Rated capacitive switching currents for DCB - back-to-back capacitor bank breaking current	A	xxxxxxxxxx
2.44		• Rated capacitive switching currents for DCB - back-to-back capacitor bank inrush making current	kA	xxxxxxxxxx
2.45		• Chopping number of the DCB	λ	xxxxxxxxxx
2.46		• Rated opening time for DCB	ms	xxxxxxxxxx
2.47		• Rated break-time for DCB (max 60ms for $U_n \leq 132\text{kV}$; max 50ms for $U_n > 132\text{kV}$)	ms	shall not exceed 60
2.48		• Rated closing time for DCB	ms	xxxxxxxxxx
2.49		• Rated open-close time for DCB	ms	xxxxxxxxxx
2.50		• Rated reclosing time for DCB	ms	xxxxxxxxxx
2.51		• Rated close-open time for DCB	ms	xxxxxxxxxx
2.52		• Rated pre-insertion time for DCB	ms	xxxxxxxxxx
2.53		• DCB mechanical endurance class		Class M2
2.54		• Number of mechanical operations for DCB		10000
2.55		• Classification of disconnecting circuit-breakers as a function of electrical endurance		Yes
		□		
3		Service conditions		
3.1		• Location (indoors/outdoors)		Outdoors
3.2		• Ambient air temperature range	°C	-10 to +40
3.3		• Solar radiation	W/m ²	1100

ESKOM COPYRIGHT PROTECTED

3.4		• Altitude (amsl) m	1800	
3.5		• Class of pollution (SANS 60815-1:2009)	Very heavy ('e')	
3.6		• Average humidity %	95	
3.7		• Wind speed (velocity) m/s	34	
3.8		• Condensation and precipitations	Yes	
3.9		• Seismic activity g	0,3	
4		General		
4.1		• DCB compliant to SANS 62271-108	Yes	
4.2		<input type="checkbox"/> DCB form or type compliant to SANS 62271-108 Annex A, Figure A.1 (IEC 1811/05)	Yes	
4.3		• DCB design (live-tank / dead-tank)	Live-tank	
4.4		• DCB manufacturer	xxxxxxxxxx	
4.5		• DCB country of origin	xxxxxxxxxx	
4.6		• DCB model/type designation	xxxxxxxxxx	
4.7		• DCB total mass kg	xxxxxxxxxx	
4.8		• CTs required	No	
4.9		<input type="checkbox"/> - CT manufacturer	N/A	
4.10		<input type="checkbox"/> - CT country of origin	N/A	
4.11		• Support structure design	2 column support with common base frame	
4.12		<input type="checkbox"/> - Steel support structure to be supplied with DCB Y/N	No	
4.13		<input type="checkbox"/> - DCB pole operation	3-pole operated (3P)	
4.14		<input type="checkbox"/> - Stored energy operation for DCB mechanism	Yes	
4.15		<input type="checkbox"/> - Energy storage device	Spring	
4.16		<input type="checkbox"/> NOTE: When a feeder DCB is in the closed position and the spring has been charged, it shall be able to "TRIP-CLOSE-TRIP" before the spring needs to be recharged	Yes	
4.17		<input type="checkbox"/> - Manual and motorised spring charging	Yes	
4.18		<input type="checkbox"/> - Manual and electric energy release	Yes	
4.19		<input type="checkbox"/> - Mechanical energy stored in charged spring kJ	xxxxxxxxxx	
4.20		<input type="checkbox"/> - Mechanical device provided to prevent over-charging of the closing spring for manual and motor charging	Yes	
4.21		<input type="checkbox"/> - Safe conditions produced in the case of	Yes	

4.22		failure to latch		
	<input type="checkbox"/>	- DCB insulation and/or extinguishing medium	SF6/Enviro-friendly	
4.23	<input type="checkbox"/>	- Type of interrupter design (puffer, self-blast, etc.)	xxxxxxxxxx	
4.24	<input type="checkbox"/>	- Configuration of moving contacts (single, double or triple motion)	xxxxxxxxxx	
4.25	<input type="checkbox"/>	- Minimum expected life-span of DCB years	> 40	
	<input type="checkbox"/>			
5		Construction requirements		
		• Design and layout of the DCB:-		
5.1	<input type="checkbox"/>	- standardised DCB elements to maximise interchangeability Y/N	Yes	
5.2	<input type="checkbox"/>	- modular, pre-assembled elements shall be designed to facilitate handling and installation Y/N	Yes	
5.3	<input type="checkbox"/>	- designed to facilitate ease of construction and maintenance Y/N	Yes	
5.4	<input type="checkbox"/>	- Filter material housing located to provide easy access during maintenance Y/N	Yes	
	<input type="checkbox"/>			
6		DCB operating mechanism enclosure requirements		
6.1		• Operating mechanisms, local control facilities and all parts requiring lubrication protected by weatherproof enclosures Y/N	Yes	
6.2	<input type="checkbox"/>	- degree of protection for enclosures containing exposed bearings, auxiliary switches, motors and other electrical devices IP	IP 55	
6.3	<input type="checkbox"/>	- degree of protection for all open areas in the DCB common base frame as well as externally mounted indicating devices (where applicable) IP	IP 2X	
6.4	<input type="checkbox"/>	- degree of protection for all other enclosures IP	IP 54	
6.5		• Operating mechanism enclosure, handles and fixings material	3CR12 stainless steel/ Painted aluminium	
6.6		• Operating mechanism enclosure corrosion protection in accordance with 5.6 of DSP 34-1658 Y/N	Yes	
6.7		• Operating mechanism enclosures arranged to facilitate easy access from all sides Y/N	Yes	
6.8	<input type="checkbox"/>	- all fastenings compliant with 240-105506460 Y/N	Yes	
6.9		• DCB designed for operation from the front of the operating mechanism enclosure Y/N	Yes	
6.10		• Access to the operating mechanism controls, terminals strips etc. provided through hinged front access door Y/N	Yes	

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **80 of 107**

6.11	<ul style="list-style-type: none"> Maximum height to top of mechanism allows servicing from ground ($U_n \leq 132\text{kV}$) or viewing indications and reading from ground ($U_n > 132\text{kV}$) 	Y/N	Yes	
6.12	<ul style="list-style-type: none"> Front access door secured with a heavy-duty locking mechanism 	Y/N	Yes	
6.13	<ul style="list-style-type: none"> Padlocking facility shackle diameter 	mm	6	
6.14	<ul style="list-style-type: none"> Front access door equipped with travel stop 	Y/N	Yes	
6.15	<ul style="list-style-type: none"> Rigid, corrosion resistant documentation pocket provided on inside of front access door, securely attached no protrusion through door 	Y/N	Yes	
6.16	<ul style="list-style-type: none"> Facilities provided for securing operating tools on inside of front access door 	Y/N	Yes	
6.17	<ul style="list-style-type: none"> Earthing of operating mechanism enclosure in accordance with 240-105506460 	mm	Yes	
6.18	<ul style="list-style-type: none"> Provision for bottom/ below entry of all control cabling into operating mechanism enclosure 	Y/N	Yes	
6.19	<ul style="list-style-type: none"> Metallic cable racking provided for inter-pole cabling? 	Y/N	No	
6.20	<ul style="list-style-type: none"> Upper surfaces of enclosure shaped/sloped to prevent the accumulation of water 	Y/N	Yes	
6.21	<ul style="list-style-type: none"> Gasket material offered 		Neoprene / Heavy-duty foam-plastic	
6.22	<ul style="list-style-type: none"> Gauze-covered drain hole provided ($> 25\text{ mm}$) 	Y/N	Yes	
6.23	<ul style="list-style-type: none"> Enclosure lifting eyes provided 		Top	
6.24	<ul style="list-style-type: none"> Enclosure colour 		Light grey (G29)	
6.25	<ul style="list-style-type: none"> Mechanical trip facility located inside mechanism enclosure 	Y/N	Yes	
7	DCB supporting structure			
	<ul style="list-style-type: none"> Mechanical loads and parameters relating to the design of the DCB support structure and foundation - 			
7.1	<input type="checkbox"/> - "static" dead weight of the DCB	N	xxxxxxxxxx	
	<input type="checkbox"/> - rated "static" tensile horizontal force (Longitudinal) F_{thA} of the DCB due to connected conductors	N	1 250	
7.2	<input type="checkbox"/> - rated "static" terminal load (horizontal resultant force) F_{shA} of the DCB due to connected conductors	N	xxxxxxxxxx	
	<input type="checkbox"/> - rated "static" tensile horizontal force (Transversal) F_{thB} of the DCB due to connected conductors	N	750	
7.3	<input type="checkbox"/> - rated "static" terminal load (horizontal resultant force) F_{shB} of the DCB due to connected conductors	N	xxxxxxxxxx	

ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **81 of 107**

7.4	<input type="checkbox"/>	- rated "static" terminal load (vertical resultant force) F_{sv} of the DCB due to connected conductors	N	xxxxxxxxxx	
7.5	<input type="checkbox"/>	- "dynamic" horizontal force exerted during operation on the foundation	N	xxxxxxxxxx	
7.6	<input type="checkbox"/>	- "dynamic" vertical force exerted during operation on the foundation	N	xxxxxxxxxx	
7.7	<input type="checkbox"/>	- "dynamic" moment (torque) exerted during operation about the foundation	Nm	xxxxxxxxxx	
7.8	<input type="checkbox"/>	- "dynamic" horizontal force exerted between DCB poles (centre phase interrupter chamber) during a rated (terminal fault) short-circuit	N	xxxxxxxxxx	
7.9	<input type="checkbox"/>	- wind force (load) exerted on the DCB	N	xxxxxxxxxx	
7.10	<input type="checkbox"/>	- maximum torque required for the foundation holding down bolt nuts	Nm	xxxxxxxxxx	
7.11	•	DCB steel support structure to be designed by manufacturer	Y/N	No	
7.12	•	DCB concrete foundation to be designed by manufacturer	Y/N	No	
7.13	•	Common base frame supplied with DCB ($U_n \leq 132$ kV)	Y / N / N/A	Yes	
7.14	•	DCB designed to interface with the standard Eskom steel support structure	Y/N	Yes	
7.15	•	DCB support structure designed to interface with the standard Eskom concrete foundation	Y/N	Yes	
7.16	•	DCB steel support structure drawing (240-105506460 Table 5)		D-DT-5200 Sh 2	
7.17	•	DCB concrete foundation drawing (240-105506460 Table 5)		D-DT-5200 Sh 1	
7.18	•	Rated static terminal according to SANS 62271-108 Clause 4.112	Y/N	Yes	
	<input type="checkbox"/>				
8		Corrosion protection and lubrication			
8.1	•	Corrosion specification		DSP 34-1658	
8.2	•	Corrosivity rating of environment		"high" to "very high"	xxxxxxxxxx
8.3	•	Minimum detailed specification number for exposed metal	DS	DS-11	xxxxxxxxxx
8.4	<input type="checkbox"/>	- Equivalent detailed specification number offered for operating mechanism enclosures	DS	xxxxxxxxxx	
8.5	<input type="checkbox"/>	- Equivalent detailed specification number offered for all bolts, nuts and washers	DS	xxxxxxxxxx	
8.6	<input type="checkbox"/>	- Equivalent detailed specification number offered for all structural steel	DS	xxxxxxxxxx	
8.7	<input type="checkbox"/>	- Equivalent detailed specification number offered for all other exposed metal (excluding main terminals)	DS	xxxxxxxxxx	
8.8	•	Details of lubricants provided with tender documentation	Y/N	Yes	

ESKOM COPYRIGHT PROTECTED

8.9		<ul style="list-style-type: none"> Details of flange arrangements, treatments to prevent flange corrosion provided with tender 	Yes	
8.10		<ul style="list-style-type: none"> Material and Corrosion Protection Information Table 6 on the 240-105506460 standard completed 	Y/N Yes	
9		DCB operating mechanism enclosure heaters		
9.1		<ul style="list-style-type: none"> Heater size offered 	Watt xxxxxxxxxx	
9.2		<ul style="list-style-type: none"> Heater control circuit specification (240-56030489 and Eskom standard wiring drawing) 	240-56030489 and D-DT-5407	
9.3		<ul style="list-style-type: none"> Heater maintains dew-point higher than ambient temperature, constantly circulates air to all parts of enclosure 	Y/N Yes	
10		Terminal requirements		
10.1		<ul style="list-style-type: none"> HV main terminal type 	Flat pad	
10.2		<ul style="list-style-type: none"> Flat pad details: 		
10.3		<input type="checkbox"/> - Number of holes and pitch	mm 8 x 50	
10.4		<input type="checkbox"/> - Thickness (min)	mm 20	
10.5		<input type="checkbox"/> - Material	Aluminium	
10.6		<ul style="list-style-type: none"> Main HV terminals shall be in accordance with SANS 62271-301 	Y/N Yes	
10.7		<ul style="list-style-type: none"> HV main terminals removable without interfering with operation of DCB 	Y/N Yes	
10.8		<ul style="list-style-type: none"> Details of main HV terminals shown on the GA 	Y/N Yes	
10.9		<input type="checkbox"/> Earthing terminals		
10.10		<ul style="list-style-type: none"> Details of earthing terminals shown on the GA 	Y/N Yes	
10.11		<input type="checkbox"/> - DCB earthed to main substation grid through support structure and foundation holding down bolts	Y/N Yes	
10.12		<input type="checkbox"/> - Earthing of DCB via steel support structure and foundation holding down bolts	Y/N Yes	
10.13		<input type="checkbox"/> - Additional conductor provided between the DCB and the support structure	Y/N Yes	
10.14		<input type="checkbox"/> - Material (preferably not exposed)	Cu/ Al Yes	
10.15		<input type="checkbox"/> - Additional Ø18 mm hole provided at bottom of steel support structure (if part of supply)	N/A	
		<input type="checkbox"/>		

11		Safety clearances and personnel safety		
11.1		• Live parts isolated by means of elevation Y/N	Yes	
11.2		• Minimum electrical working clearance (240-105506460 Table 7) mm	3950	
11.3		• Distance from lowest part of any high-voltage insulation above ground mm	2500	
11.4		• Type of pressure relief devices provided	xxxxxxxxxx	
11.5		<input type="checkbox"/> Safe working procedure compliance to OHS Act provided	Yes	
12		Insulation requirements		
		• Hollow insulators		
12.1		<input type="checkbox"/> - Insulator material	Ceramic DILO fitting/ Silicone rubber composite	
12.2		<input type="checkbox"/> - Insulator manufacturer	xxxxxxxxxx	
12.3		<input type="checkbox"/> - Ceramic type insulators in accordance with SANS 62155 and SANS 60815-2 Y/N	Yes	
12.4		<input type="checkbox"/> - Silicone rubber composite type insulators in accordance with SANS 61462 and SANS 60815-3 Y/N	Yes	
12.5		<input type="checkbox"/> - DCB tested at KIPTS Y/N	No	
		• Minimum insulation creepage distances (SANS 60815-1)		
12.6		<input type="checkbox"/> - Minimum external unified specific creepage distance (USCD) mm/kV	53,7	
		• Clearances in air		
12.7		<input type="checkbox"/> - Phase to phase clearance in air mm	xxxxxxxxxx	
12.8		<input type="checkbox"/> - Phase to earth clearance in air mm	xxxxxxxxxx	
		<input type="checkbox"/>		
13		Position / status indication		
		• DCB position indication -		
13.1		<input type="checkbox"/> - Position indication to SANS 62271-1 Y/N	Yes	
13.2		<input type="checkbox"/> - Position indication visible with operating mechanism enclosure front access door closed Y/N	Yes	
13.3		<input type="checkbox"/> - Closed position: "I" in white lettering on a red background Y/N	Yes	
13.4		<input type="checkbox"/> - Open position: "O" in white lettering on a green background Y/N	Yes	
13.5		<input type="checkbox"/> - Lettering (symbol) size (min) mm	30	
		• Closing spring status indication		

13.6	<input type="checkbox"/>	- Status indicated by "SPRING CHARGED" and "SPRING DISCHARGED"	Y/N	Yes	
13.7	<input type="checkbox"/>	- Lettering size (min)	mm	15	
13.8		• Type of non-resettable DCB operation counter offered		Mechanical / electrical	
13.9		• Pressure gauge provided (compensated for temperature and responding to insulation and/or extinguishing medium density) - where applicable	Y/N	Yes	
13.10		• Pressure gauge sheltered from the elements - where applicable	Y/N	Yes	
	<input type="checkbox"/>				
14		Labels			
		• Operating labels			
14.1	<input type="checkbox"/>	- Instructions for tripping ("TO TRIP") and closing ("TO CLOSE") the DCB	Y/N	Yes	
14.2	<input type="checkbox"/>	- Instructions for charging closing springs ("TO CHARGE SPRING")	Y/N	Yes	
14.3		• Actuator(s) for local opening and closing of the DCB labelled in accordance with 40-105506460. NOTE The trip/close actuator colour differ from IEC 60073	Y/N	Yes	
14.4		• Warning labels for manual operation; mechanical trip facility; interval between repeated CO's at testing	Y/N	Yes	
		• Function labels			
14.5	<input type="checkbox"/>	- Function labels provided to identify all LV (secondary) control equipment	Y/N	Yes	
14.6	<input type="checkbox"/>	- Function label text height (min)	mm	5	
14.7		• Labels manufactured to 240-56062515	Y/N	Yes	
	<input type="checkbox"/>				
15		Requirements for SF₆ gas (where applicable)			
		NOTE The Supplier shall provide details of other environmental friendly insulation and/or extinguishing medium if applicable			
15.1		• SF ₆ in accordance with IEC 60376	Y/N	Yes	
15.2		• The maximum SF ₆ gas leakage rate (NB: provide details if other enviro-friendly insulation and/or extinguishing medium)	%	0,5 / year	
		• SF ₆ gas purity			
15.3	<input type="checkbox"/>	- SF ₆ content	%	>98	
15.4	<input type="checkbox"/>	- Dew point at rated filling pressure (max) (at +20°C)	°C & μL/L	>-10	

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **85 of 107**

		<ul style="list-style-type: none"> SF6 gas-filled DCB filling and pressure monitoring (NB: provide details if other enviro-friendly insulation and/or extinguishing medium) 		
15.5		<input type="checkbox"/> - central gas/filling evacuation point connection provided	DILO DN8	
15.6		<input type="checkbox"/> - height of gas filling/evacuation point above ground (max) mm	2400	
15.7		<input type="checkbox"/> - gas filling point and the gas pressure gauge separated Y/N	Yes	
15.8		<input type="checkbox"/> - dial type gauge responding to Density and indicating pressure compensated for temperature provided Y/N	Yes	
15.9		<input type="checkbox"/> - Density monitoring device (density switch) contact requirements	D-DT-5407	
15.10		<input type="checkbox"/> - Density monitoring device suitable for outdoor operation Y/N	Yes	
15.11		<input type="checkbox"/> - method/system used to prevent corrosion of moving parts and contacts	xxxxxxxxxx	
15.12		<input type="checkbox"/> - Density monitoring device shielded against direct sunshine Y/N	Yes	
15.13		<input type="checkbox"/> - non-return valves fitted on all DN8/DN20 fittings and pipe work to allow removal of poles and/or density monitoring device while maintaining system pressure Y/N	Yes	
15.14		<input type="checkbox"/> - details of arrangement offered supplied with tender documentation Y/N	Yes	
15.15		<input type="checkbox"/> - pipe work material	Cu	
15.16		<input type="checkbox"/> - separate/common filling/evacuating and density monitoring point per pole provided	Common	
15.17		<input type="checkbox"/> - type of electrical connections to the density-monitoring device	xxxxxxxxxx	
15.18		<input type="checkbox"/> - cabling protected using compression glands/grommets Y/N	Yes	
15.19		<input type="checkbox"/> - details of all pressure devices provided with tender documentation Y/N	Yes	
15.20		<input type="checkbox"/> - Density monitoring device electrical interlocks and alarm requirements	240-56030489 and D-DT-5407	
15.21		<ul style="list-style-type: none"> Management of SF₆ gas in accordance with NRS 087 Y/N 	Yes	
		<input type="checkbox"/>		
16		Current Transformers		
16.1		<ul style="list-style-type: none"> Type of CT design 	N/A	
16.2		<ul style="list-style-type: none"> CT specification 	N/A	
16.3		<ul style="list-style-type: none"> Number of cores 	N/A	
16.4		<ul style="list-style-type: none"> CT specification (drawing number) 	N/A	
16.5		<ul style="list-style-type: none"> Rated short-time withstand current - magnitude kA 	N/A	
		<input type="checkbox"/> Rated short-time withstand current - duration s	N/A	

ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **86 of 107**

16.6		• Position relative to the DCB	N/A	
16.7		• Terminal numbering and wiring interface (drawing number)	N/A	
		• Protection current transformers:		
16.8		<input type="checkbox"/> a) cores	N/A	
16.9		<input type="checkbox"/> b) class	N/A	
16.10		<input type="checkbox"/> c) ratios A	N/A	
		• Bus-zone current transformers:		
16.11		<input type="checkbox"/> a) cores	N/A	
16.12		<input type="checkbox"/> b) class	N/A	
16.13		<input type="checkbox"/> c) ratios A	N/A	
		• Measurement current transformers:		
16.14		<input type="checkbox"/> a) cores	N/A	
16.15		<input type="checkbox"/> b) class	N/A	
16.16		<input type="checkbox"/> c) burden VA	N/A	
16.17		<input type="checkbox"/> d) ratios A	N/A	
16.18		• Details of the calculated magnetising curves provided on a log-scale Y/N	Yes	
16.19		• Details of protection against mechanical damage and fixing method provided Y/N	Yes	
16.20		• Ring-type CTs interchangeable without dismantling the bushing, this method provided with tender documentation	N/A	
		<input type="checkbox"/>		
17		Switching surge control (where applicable)		
17.1		• Pre-insertion closing resistor parallel to interrupter NOT offered Y/N	xxxxxxxxxx	xxxxxxxxxx
17.2		• Proposed method for switching surge control offered Y/N	xxxxxxxxxx	
17.3		• Electronic controller offered for switching of cap banks, reactor banks and transformers (Provide Manufacturer & Type, IEC 61850 protocol compliancy) Y/N	Yes	
		<input type="checkbox"/>		
18		Grading capacitors (where applicable)		
18.1		• Grading capacitors parallel to interrupter NOT offered Y/N	xxxxxxxxxx	xxxxxxxxxx
18.2		• Proposed method for voltage distribution across the DCB with two or more interrupters offered Y/N	xxxxxxxxxx	
18.3		• Details of how to verify condition of the method employed for voltage distribution across two or more interrupters during the life of the DCB provided with the tender documentation Y/N	Yes (where applicable)	
		<input type="checkbox"/>		

ESKOM COPYRIGHT PROTECTED

19		Extreme asymmetrical short-circuit interrupting capability (where applicable)		
19.1		<ul style="list-style-type: none"> DCB required to interrupt short-circuit currents with a higher degree of asymmetry than required by SANS 62271-100 Y/N 	No	
19.2		<ul style="list-style-type: none"> Proof of higher asymmetrical interrupting capability provided with tender documentation Y/N 	Yes (where applicable)	
		<input type="checkbox"/>		
20		Requirements for simultaneity of poles during single closing and single opening operations		
20.1		<ul style="list-style-type: none"> Contact synchronism retained within rated values during the expected maintenance interval of DCB Y/N 	Yes	
20.2		<input type="checkbox"/> - time interval between contact touch for all poles of the DCB ms	< 5	
20.3		<input type="checkbox"/> - time interval between contact touch for interrupters in the same pole ms	< 3.3	
20.4		<input type="checkbox"/> - time interval between contact touch for individual closing resistors - where applicable ms	< 10	
20.5		<input type="checkbox"/> - time interval between contact touch for individual closing resistors in the same pole (series connected) - where applicable ms	< 6,6	
20.6		<input type="checkbox"/> - time interval between contact separation for all poles of the DCB ms	< 3,3	
20.7		<input type="checkbox"/> - time interval between contact separation for interrupters in the same pole ms	< 2.5	
		<input type="checkbox"/>		
21		Controlled switching		
21.1		<ul style="list-style-type: none"> All information and details provided with the tender documentation (Controller is IEC61850 protocol compliant) Y/N 	Yes	
		<input type="checkbox"/>		
22		Pole discordance (PD) or phase discrepancy		
22.1		<ul style="list-style-type: none"> All information and details provided with the tender documentation Y/N 	Yes	
		<input type="checkbox"/>		
23		Auxiliary and control circuits		
23.1		<ul style="list-style-type: none"> Auxiliary and control circuit requirements ($\geq 220\text{kV}$ use 0.54/07529 (Live-tank CB's) & 0.54/8557 (Dead-tank CB's)) 	240-56030489 and D-DT-5407	
23.2		<ul style="list-style-type: none"> Auxiliary power supplies: 		
		<input type="checkbox"/> - Provision	On site by Eskom	
23.3		<input type="checkbox"/> - Peak power requirement (max) VA	xxxxxxxxxx	
23.4		<input type="checkbox"/> - Standby power requirements VA	xxxxxxxxxx	
		<ul style="list-style-type: none"> DCB spring-charging motor control circuit (per mechanism): 		
23.5		<input type="checkbox"/> - d.c. supply voltage range of operation %	85 to 110	
23.6		<input type="checkbox"/> - d.c. current (peak starting) A	< 30	

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **88 of 107**

23.7	<input type="checkbox"/>	- d.c. current (max continuous)	A	< 10	
23.8	<input type="checkbox"/>	- total time taken to charge spring	s	< 10	
23.9	<input type="checkbox"/>	- method offered for protection against continual motor running (over-run)		xxxxxxxxxx	
23.10	<input type="checkbox"/>	- automatic charging of closing spring		Yes	
23.11	<input type="checkbox"/>	- number of spare contacts of SLS provided (≥220kV use 0.54/07529 (LTCB's) & 0.54/8557 (DTCB's))		D-DT-5407	
	•	DCB closing control circuit (per mechanism):			
23.12	<input type="checkbox"/>	- d.c. supply voltage range of operation	%	85 to 110	
23.13	<input type="checkbox"/>	- d.c. power (peak)	W	≤ 500	
23.14	<input type="checkbox"/>	- number of close coils required		1	
23.15	<input type="checkbox"/>	- close coil current	A	xxxxxxxxxx	
23.16	<input type="checkbox"/>	- close coil resistance @ 20°C	Ω	xxxxxxxxxx	
	•	DCB tripping control circuit (per mechanism):			
23.17	<input type="checkbox"/>	- d.c. supply voltage range of operation	%	70 to 110	
23.18	<input type="checkbox"/>	- d.c. power (peak)	W	≤ 500	
23.19	<input type="checkbox"/>	- number of trip coils required		2	
23.20	<input type="checkbox"/>	- physically and electrically separate trip control circuits		Yes	
23.21	<input type="checkbox"/>	- trip circuit supervision		Yes	
23.22	<input type="checkbox"/>	- trip coils rated to carry 20mA d.c. continuously		Yes	
23.23	<input type="checkbox"/>	- trip coil current	A	xxxxxxxxxx	
23.24	<input type="checkbox"/>	- trip coil resistance @ 20°C	Ω	xxxxxxxxxx	
23.25	•	DCB equipped with anti-pumping circuitry		Yes	
23.26	•	d.c. isolation switch provided		Yes	
23.27	•	DCB control circuit interlocks specification		240-56030489 and D-DT-5407	
23.28	•	DCB alarm circuits wiring specification		240-56030489 and D-DT-5407	
	•	Auxiliary contacts provided (spare for Eskom use):			
	<input type="checkbox"/>	Duty rating			
23.29	<input type="checkbox"/>	- a.c. and d.c. supply current	A	10	
23.30	<input type="checkbox"/>	- N/O and N/C contact reference positions (≥220kV use 0.54/07529 (LTCB's) & 0.54/8557 (DTCB's))		Circuit-breaker opened, spring discharged, gas low, relay coils de-energised	
	<input type="checkbox"/>	Low insulation and/or extinguishing medium alarm			
23.31	<input type="checkbox"/>	- N/O		0	
23.32	<input type="checkbox"/>	- N/C		2	
	<input type="checkbox"/>	Low insulation and/or extinguishing medium block contacts			
23.33	<input type="checkbox"/>	- N/O		0	
23.34	<input type="checkbox"/>	- N/C		2	
	<input type="checkbox"/>	Spare DCB auxiliary switch contacts (per mechanism) (≥220kV use 0.54/07529 (LTCB's) & 0.54/8557 (DTCB's))			

ESKOM COPYRIGHT PROTECTED

DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE

Unique Identifier: 240-105506460

Revision: 1

Page: 89 of 107

23.35	<input type="checkbox"/>	- N/O	4	
23.36	<input type="checkbox"/>	- N/C	4	
	<input type="checkbox"/>	Spare DCB spring limit switch contacts (per mechanism) ($\geq 220\text{kV}$ use 0.54/07529 (LTCB's) & 0.54/8557 (DTCB's))		
23.37	<input type="checkbox"/>	- N/O	3	
23.38	<input type="checkbox"/>	- N/C	3	
	•	Terminal blocks and terminal strips:		
23.39	<input type="checkbox"/>	- Number of spare terminals provided	≥ 6	
23.40	<input type="checkbox"/>	- Terminal blocks to DSP 34-253, screw clamp, spring-loaded insertion type ($\geq 220\text{kV}$ use 0.54/07529 (LTCB's) & 0.54/8557 (DTCB's))	Yes	
23.41	<input type="checkbox"/>	- Terminal block width offered (above 132kV use 0.54/07529 (LTCB's) & 0.54/8557 (DTCB's)) mm	≥ 8	
23.42	<input type="checkbox"/>	- Make of terminal block offered ($\geq 220\text{kV}$ use 0.54/07529 (LTCB's) & 0.54/8557 (DTCB's))	xxxxxxxxxx	
23.43	•	Lugs (insulated hook blade type)	Crimped	
23.44	•	Earth sliding link types/equivalents ($\geq 220\text{kV}$ use 0.54/07529 (LTCB's) & 0.54/8557 (DTCB's))	Weidmuller TVP SAKA 10	
23.45	•	Trunking provided on both sides of each terminal strip	Yes	
23.46	•	'Fine-tooth' trunking tooth width mm	6,1	
23.47	•	Trunking size mm	60 x 60	
	•	Wiring size:		
23.48	<input type="checkbox"/>	- CT and motor control circuit wires mm ²	2,5	
23.49	<input type="checkbox"/>	- Control and other auxiliary wires mm ²	1,5	
23.50	<input type="checkbox"/>	- Minimum number of strands	7	
	•	Wiring colour:		
23.51	<input type="checkbox"/>	- CT wires	red/white/blue/black	
23.52	<input type="checkbox"/>	- Earth wires	green/yellow	
23.53	<input type="checkbox"/>	- All other wires	grey	
23.54	•	Wiring identification	Ferruling	
23.55	•	Terminal strips numbered and designated as per drawing	D-DT-5407	
	•	LV MCBs:		
23.56	<input type="checkbox"/>	- MCBs to SANS 60947-2 and IEC 60898	Yes	
23.57	<input type="checkbox"/>	- Make and type offered	xxxxxxxxxx	
23.58	<input type="checkbox"/>	- I_{cu} A	xxxxxxxxxx	
23.59	<input type="checkbox"/>	- I_{cs} A	xxxxxxxxxx	
23.60	<input type="checkbox"/>	- Utilisation category (SANS 60947-2)	'A'	
23.61	<input type="checkbox"/>	- Max service voltage V	xxxxxxxxxx	
23.62	<input type="checkbox"/>	- d.c. MCB rated voltage V	≥ 250	
23.63	<input type="checkbox"/>	- Pollution degree (SANS 60947-2)	≥ 3	
23.64	<input type="checkbox"/>	- Suitable for isolation (SANS 60947-2)	Yes	
23.65	<input type="checkbox"/>	- Protection curve (SANS 60947-2 / IEC 60898)	'C'	

ESKOM COPYRIGHT PROTECTED

23.66		<input type="checkbox"/> - Location		Mechanism enclosure	
23.67		<ul style="list-style-type: none"> DCB auxiliary and control circuit wiring interface (drawing number) ($\geq 220\text{kV}$ use 0.54/07529 (LTCB's) & 0.54/8557 (DTCB's)) 		D-DT-5407	
23.68		<ul style="list-style-type: none"> Bottom entry removable brass/aluminium LV gland plates provided 	Y/N	Yes	
23.69		<ul style="list-style-type: none"> Terminal strips shall be arranged in a vertical orientation 	Y/N	Yes	
23.70		<ul style="list-style-type: none"> Earthing point inside mechanism enclosure provided, allows 10 spare secondary control cable cores 	Y/N	Yes	
		<input type="checkbox"/>			
24		Nameplates			
		<ul style="list-style-type: none"> Nameplates provided for the following: 			
24.1		<input type="checkbox"/> - DCB (SANS 62271-108)	Y/N	Yes	
24.2		<input type="checkbox"/> - DCB operating mechanism (SANS 62271-108)	Y/N	Yes	
24.2		<input type="checkbox"/> - CT (SANS 60044-1 / NRS 029)	Y/N	N/A	
24.3		<ul style="list-style-type: none"> Method used to attach nameplates (riveted or screwed on) 		xxxxxxxxxx	
24.4		<ul style="list-style-type: none"> Nameplate material offered (engraved aluminium or stainless steel) 		xxxxxxxxxx	
24.5		<ul style="list-style-type: none"> Duplicate nameplates provided for CTs on inside of operating mechanism enclosure front access door 	Y/N	N/A	
		<input type="checkbox"/>			
25		Tools and spares			
		<ul style="list-style-type: none"> Tools to be supplied with DCB (minimum requirements): 			
25.1		<input type="checkbox"/> - full set of operating tools (Has the list on separate sheet been provided?)	Sets	1 set per DCB	
25.2		<input type="checkbox"/> - tools fitted on inside of the front access door	Y/N	Yes	
25.3		<ul style="list-style-type: none"> Standard tools available for minor maintenance (Has the list on separate sheet been provided?) 	Y/N	Yes	
25.4		<ul style="list-style-type: none"> Specialised tools available for major maintenance purposes (Has the list on separate sheet been provided?) 	Y/N	Yes	
25.5		<ul style="list-style-type: none"> Spares available for maintenance (Has the list on separate sheet been provided?) 	Y/N	Yes	
25.6		<input type="checkbox"/> Written letter, in case of design obsolescence has been provided?	Y/N	Yes	
26		Documentation			
		Note: All tender documentation to be provided in electronic format. <ul style="list-style-type: none"> Documentation to be supplied with tender: 			

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **91 of 107**

26.1	<input type="checkbox"/> - GA drawing (provide drawing number on separate sheet provided)	Sets	1	
26.2	<input type="checkbox"/> - Drawing of all insulators used in the DCB (provide drawing number on separate sheet provided)	Sets	1	
26.3	<input type="checkbox"/> - Generic layout of nameplates (provide drawing number on separate sheet provided)	Sets	1	
26.4	<input type="checkbox"/> - Generic auxiliary and control circuit schematic wiring diagram (provide drawing number on separate sheet provided)	Sets	1	
26.5	<input type="checkbox"/> - GA drawing of the operating mechanism enclosure	Sets	1	
26.6	<input type="checkbox"/> - list of spare parts with prices for each DCB offered (provide list on separate sheet provided)	Sets	1	
26.7	<input type="checkbox"/> - list of all operating tools for each DCB offered (Has the list on separate sheet been provided?)	Sets	1	
26.8	<input type="checkbox"/> - list of all standard minor maintenance tools for each DCB offered (Has the list on separate sheet been provided?)	Sets	1	
26.9	<input type="checkbox"/> - list of all specialised major maintenance tools for each DCB offered (Has the list on separate sheet been provided?)	Sets	1	
26.10	<input type="checkbox"/> - full list as well as copies of type test certificates and reports (Has the report numbers on separate sheet been provided?)	Sets	1	
26.11	<input type="checkbox"/> - generic routine test certificates for each DCB	Sets	1	
26.12	<input type="checkbox"/> - transport, storage, installation, operating and maintenance manuals	Sets	1	
26.13	<input type="checkbox"/> - training material	Sets	1	
26.14	<input type="checkbox"/> - generic quality inspection and test plan (QITP)	Sets	1	
26.15	<input type="checkbox"/> - all other relevant additional information requested	Sets	1	
	• Documentation to be supplied with each DCB:			
26.16	<input type="checkbox"/> - Schematic wiring diagram for DCB	Sets	1	
26.17	<input type="checkbox"/> - Complete set of routine test certificates for DCB	Sets	1	
26.18	<input type="checkbox"/> - Commissioning and hand-over test sheet	Sets	1	
26.19	<input type="checkbox"/> - Transport, storage, installation, operating and maintenance manuals	Sets	1	
26.20	• Submission of documentation requested upon awarding of contract	Y/N	Yes	
26.21	• Units used in Republic of South Africa		In tender/offer	
26.22	• Project reference list, service to Eskom		In tender/offer	
	<input type="checkbox"/>			
27	Packaging requirements			
27.1	• Each individual DCB unit packed	Y/N	Yes	

ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **92 of 107**

27.2		<ul style="list-style-type: none"> Containers (e.g. wooden crates) suitable for transport and storage over long periods (for up to 18 months) (NB: preservation requirements in QM-58) 	Y/N	Yes	
27.3		<ul style="list-style-type: none"> Durable waterproof packaging designed to prevent damage to components during transportation and storage on site 	Y/N	Yes	
27.4		<ul style="list-style-type: none"> Suitable ventilation provided to minimise condensation 	Y/N	Yes	
27.5		<ul style="list-style-type: none"> Packaging able to withstand impact loadings of at least 18 kN 	Y/N	Yes	
27.6		<ul style="list-style-type: none"> Each crate clearly and sequentially marked 	Y/N	Yes	
27.7		<ul style="list-style-type: none"> Each container/crate clearly marked with a durable label using an indelible font with all specified information in 240-105506460 	Y/N	Yes	
27.8		<ul style="list-style-type: none"> Exposed shafts, bearings and machined surfaces treated with a temporary anti-corrosive coating 	Y/N	Yes	
27.9		<ul style="list-style-type: none"> Loose components or components that are subject to damage from exposure to dust or water packed in hermetically sealed plastic bags 	Y/N	Yes	
27.10		<ul style="list-style-type: none"> All components clearly marked 	Y/N	Yes	
27.11		<ul style="list-style-type: none"> Fork-lift lifting points provided on the packaging - where applicable 	Y/N	Yes	
27.12		<ul style="list-style-type: none"> External temporary 230 V a.c. connection point for the heater circuit provided 	Y/N	Yes	
27.13		<ul style="list-style-type: none"> Non-resettable impact recorder/detector provided 	Y/N	Yes	
27.14		<ul style="list-style-type: none"> DCB transported with a positive gas pressure of maximum 150 kPa - where applicable 	Y/N	Yes	
27.15		<ul style="list-style-type: none"> Copy of the BOM shall be provided with the delivery note 	Y/N	Yes	
		<input type="checkbox"/>			
28		Miscellaneous			
28.1		<ul style="list-style-type: none"> General Test equipment used for precommissioning in accordance with 240-105506460 	Y/N	Yes	
28.2		<ul style="list-style-type: none"> Written commitment to provide Inspection and maintenance DVD has been provided with tender docs 	Y/N	Yes	
28.3		<ul style="list-style-type: none"> Required period for spares availability 	Years	25 years after discontinuation of switchgear	
28.4		<input type="checkbox"/> Availability of trip coils, close coils, spring charging motors, density monitoring devices, contactors & relays	Hours	12	
28.5		<ul style="list-style-type: none"> Specification sheets, speed calculation points, travel curve values shall be provided at contract awarding 	Y/N	Yes	

ESKOM COPYRIGHT PROTECTED

29 29.1	3.7	Training Requirements <ul style="list-style-type: none">Training offered in accordance with 240-56065202	Y/N	Yes	

SIGNATURES

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

**Annex C – TECHNICAL SCHEDULES A & B for PIUs in accordance with EST
240-64685228****Requirements per specific IED****Schedule A: Purchasers specific requirements****Schedule B: Guarantees and technical particulars of equipment offered**

3	Requirements (per specific IED)	Unit	Schedule A	Schedule B
-	IED Type		Switchgear PIU	
3.2	Hardware and Firmware			
3.2.1	Manufacturer type designation			
a	Model number		Specify	
b	Hardware version		Specify	
c	Firmware version		Specify	
3.4	Input energising current (CT inputs)			
3.4.1	Number of three phase CT inputs		N/A	
3.4.2	Number of three phase CT inputs with Neutral input		N/A	
3.4.3	Number of single phase/neutral CT inputs		N/A	
3.4.4	Number of Sensitive Earth Fault CT inputs		N/A	
3.5	Input energising voltage (VT inputs)			
3.5.1	Number of three phase VT inputs		N/A	
3.5.2	Number of single phase VT inputs		N/A	
3.6	DC Auxiliary energising voltage			
3.6.1	Nominal DC voltage (ordering option per application)	V	110 or 220	
3.7	DC Binary inputs			
3.7.1	Number of binary inputs (Nominal voltage)		Specify	
3.7.2	Number of binary inputs (48V)		N/A	
3.7.3	Number of binary inputs (24V)		N/A	
3.8	Binary Outputs (output contacts)			
3.8.1	Number of high-break output contacts		Specify	
3.8.2	Number of standard output contacts		Specify	
3.9	Analogue transducer inputs and outputs			
3.9.1	Number of analogue transducer inputs		N/A	
3.9.2	Number of analogue transducer outputs		N/A	
3.10	Indications			
3.10.1	Number of LED indications		Specify	

3.11	Display			
3.12	Push buttons			
3.12.1	Number of integrated push buttons		Specify	
3.16	Communication ports and protocols			
3.16.2	Number of fibre optic Ethernet ports (rear)		Specify	
3.16.3	Number of copper Ethernet ports (rear)		N/A	
3.17	Event recording and oscillography			
3.17.1	Oscillographic recorder No. analogue channels		N/A	
3.17.2	Oscillographic recorder No. digital channels		N/A	

**TECHNICAL SCHEDULES A & B FOR
SWITCHGEAR PIUs IN ACCORDANCE WITH EST 240-64685228**

Requirements per IED product family

Schedule A: Purchasers specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

3	Requirements (per IED family)	Unit	Schedule A	Schedule B
-	Manufacturer product family/series name		Specify	
3.1	Environmental conditions			
	Requirements as per specification		Noted	
3.2	Hardware and Firmware			
	Requirements as per specification		Noted	
3.2.11	IEDs shall not employ any method of forced cooling.		Comply	
3.2.13	Support of IEC 61850 Logical Node LPHD as per 240-42066934. Attributes serial number, model name/number and location shall be supported.		Comply	
3.2.14	Provision of a self supervision function as per specification		Comply	
3.3	Global ratings			
3.3.1	Nominal frequency	Hz	N/A	
3.3.1	Required operating range	Hz	N/A	
3.4	Input energising current (CT inputs)			
3.4.1a	Nominal current: Phase, Earth Fault	A	N/A	
3.4.1b	Nominal current: Sensitive Earth Fault (where applicable)	A	N/A	
3.4.2	Saturation current (linear) rating	I _{Nom}	N/A	
3.4.3a	Continuous overload	A	N/A	
3.4.3b	Short time overload: 1 second	A	N/A	
3.4.4	Burden per phase at I _{Nom}	VA	N/A	
3.4.5	Details provided on hardware and software filtering		N/A	
3.5	Input energising voltage (VT inputs)			
3.5.1a	Nominal voltage (phase-to-phase)	V	N/A	
3.5.1b	Nominal voltage (phase-to-neutral)	V	N/A	
3.5.2a	Continuous overload	V _{Nom}	N/A	
3.5.2b	Short time overload: 3 second	V _{Nom}	N/A	
3.5.3	Burden per phase at V _{Nom}	VA	N/A	
3.5.4	Details provided on hardware and software filtering		N/A	

ESKOM COPYRIGHT PROTECTED

DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE

Unique Identifier: 240-105506460

Revision: 1

Page: 97 of 107

3.6	DC Auxiliary energising voltage			
3.6.1	Nominal DC voltage (as per circuit-breaker ordering option)	V _{DC}	110 or 220	
3.6.2	Operating range	V _{Nom}	0.8 to 1.2	
3.6.3	Quescent burden	W	≤ 50	
3.6.100	Additional burden per energised opto input	W	Specify	
3.6.101	Additional burden per energised output contact	W	Specify	
3.6.102	Power up time	s	Specify	
3.7	DC Binary inputs			
3.7.1	Nominal voltage (V _{Nom})	V _{DC}	As per (3.5a)	
3.7.2	Nominal voltage (V _{Nom}) - special inputs (where applicable)	V _{DC}	N/A	
3.7.3	Requirements as per specification		Noted	
3.7.4a	Pick-up threshold range	V _{Nom}	0.70 to 0.80	
3.7.4b	Reset threshold range	V _{Nom}	0.60 to 0.70	
3.7.5	Pick-up time with AC/contact bounce rejection	ms	< 10	
3.8	Output contacts			
3.8.1(a)	High-break contacts			
i	Make and carry for 200ms at 250 Vdc	A	30	
ii	Carry for 1s at 250 Vdc	A	10	
iii	Carry continuously at 250 Vdc	A	5	
iv	Break (inductive L/R = 40ms) at 250V dc	A	10	
v	Duty cycle		3 ops in 3 sec	
vi	Durability: operations under load		> 10 000	
vii	Operate time	ms	Specify	
3.8.1(b)	Standard contacts			
i	Make and carry for 200ms at 250 Vdc	A	30	
ii	Carry for 1s at 250 Vdc	A	10	
iii	Carry continuously at 250 Vdc	A	5	
iv	Break (inductive L/R = 40ms) at 250V dc	A	0.2	
v	Durability: operations under load		> 10 000	
vi	Operate time	ms	Specify	
3.9	Analogue transducer inputs and outputs			
3.9.2	Signal type		N/A	
3.9.3	Maximum output current	I _{Nom}	N/A	
3.9.4	Maximum load on outputs	Ohm	N/A	
3.9.5	Response time to 0 - 100% step change		N/A	

ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **98 of 107**

3.9.6	Maximum full scale error	%	N/A	
3.10	Indications			
3.10.2	Indications provided by		LED, LCD text	
3.10.3	Colours supported		Tricolour: R,Gr,Amber	
3.10.4	Indications visible by default (without manual intervention)		Comply	
3.10.5	Alarm reset types supported:			
a	Follow		Yes	
b	Latching, manual reset		N/A	
c	Latching, manual/auto reset		N/A	
3.10.6	Resettable via external HMI and via the IED front panel		N/A	
3.10.7	Lamp test function as per specification		N/A	
3.11	Display			
3.11.1	On-board back-lit display provided		Specify	
3.11.2	Display life as per IED design life		Yes (where provided)	
3.11.3	Is a screen saver feature required/provided to achieve design life?		Specify	
3.11.4	Default display of analogues as per specification		N/A	
3.11.5	Display of multiple sets of analogue data (as required)		N/A	
3.11.6a	Mimic provided		N/A	
3.11.6b	Can mimic be hidden		N/A	
3.12	Push buttons			
	Requirements as per specification		N/A	
3.12.5	Actuating principles		N/A	
3.12.6	Guards provided, or double action operation		N/A	
3.12.7	Identification of circuit-breaker controls		N/A	
3.13	Programmable logic			
3.13.1	Support for logical gates: AND, OR, NOT, timers, flip-flops, counters		N/A	
3.13.2	Flip-flop and counter states are stored in non-volatile memory		N/A	
3.13.3	Virtual outputs (internal variables) are provided		N/A	
3.14	Setting groups			
3.14.1	Number of settings groups		N/A	
3.14.2	Settings groups activated by MMS and via binary input		N/A	

ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **99 of 107**

3.15	Security			
3.15.2	Levels of role based access supported		≥ 3	
3.15.3	Password settable via rear Ethernet port		Yes	
3.15.4	Password length	Char	≥ 16	
3.15.5	Support for numeric, alpha and special characters		Yes	
3.15.6	Support detection and reporting of changes as per specification		Yes	
3.16	Communication ports and protocols			
3.16.1	Communication ports			
1	Front port			
a	Port type		Ethernet, USB, RS 232	
b	Protocol		Specify	
2	Rear ports			
a	Fibre optic communication type		100BaseFX (1300nm)	
b	Fibre optic cable type		50/125µm or 62.5/125µm MM	
c	Fibre optic connectors		LC (pref) or ST	
d	Optical budget	dB	Specify	
3	One multi-session or two separate ports provided		Yes	
4	Independently settable IP addresses for each port		Yes	
3.16.2	Communication protocol			
1	IEC 61850 supported as standard.		Yes	
3a	Protocol for remote engineering access		Specify	
3a	Remote Access protocol conforms to 240-64038621		Yes	
3.17	Real time clock and Time synchronisation			
	Requirements as per specification		Noted	
3.17.1	Real time clock provided, suitable for 30 year IED operation		Yes	
3.17.2	Time drift per day (unsynchronised)	s	<2	
3.17.5	Clock back-up energy storage device			
a	Type (e.g. battery, capacitor)		Specify	
b	If battery, minimum lifespan	yrs	10	
c	If battery, replaceable without soldering		Yes	
3.17.7	Time synchronisation provided by		SNTP or PTP	
3.17.8	SNTP guaranteed accuracy	ms	< 10	
3.17.10	Support for local time offsetting from UTC		Yes	

ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **100 of 107**

3.18	Event recorder and Oscillography			
	Requirements as per specification		N/A	
3.18.2	Event recorder storage capacity	events	N/A	
3.18.5	Oscillography analogue signal sampling rate	kHz	N/A	
3.18.6	Oscillography digital signal sampling rate	kHz	N/A	
3.18.7	Settable oscillography recording length	s	N/A	
3.18.8	Total oscillography recording time stored	s	N/A	
3.18.10	Oscillography recorded analogue values		N/A	
3.18.11	COMTRADE file format supported		N/A	
3.18.12	Recordings time stamped, non-volatile storage		N/A	
3.19	Software			
3.19.1	Software package			
	Requirements as per specification		Noted	
-	Software name		Specify	
-	Software version number		Specify	
3	Software backwards compatible with Eskom's installed base?		Yes	
4	Corporate software licence provided		Yes	
5	Software costs (if any) to be recovered via IED sales		Noted	
6	Eskom may copy and distribute software for Eskom use		Yes	
11	Software compatibility with Microsoft Windows		XP and 7	
12	Software requires PC administrator rights to operate		No	
3.19.2	Software functions			
1	All listed functions supported		Yes	
3.19.3	Setting file data exchange			
2	Bi-directional exchange of settings with Microsoft Excel.		Yes	
4	Open source setting file format for exchange		ASCII; *.xml; *.xls; *.csv; *.xrio; *.mdb	
6	All application-specific changes via device settings		Yes	
7	All settings and configurations uploadable to front and rear ports		Yes	
3.19.4	Event recording and oscillography data exchange			
1	Protocols supported		MMS file services (pref), HTTPS, FTP	

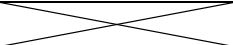
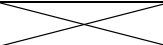
ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **101 of 107**

3.20	IED simulation models						
3.20.1a	Models available					Yes	
3.20.1b	Model format (pref: DigSilent PowerFactory)					Specify	
3.21	Documentation						
	Requirements as per specification					Noted	
3.21.2	Manuals reflect specific model numbers and firmware offered					Yes	
3.21.3	Manuals available in English					Yes	
3.21.6	Manuals available in searchable *.pdf format					Yes	
3.21.8	Microsoft Excel settings sheet provided					Yes	
3.21.10	Settings guideline provided					Yes	
3.22	Design life & in-service experience						
3.22.1	IED design life				yrs	> 20	
3.22.2	Operating record and in service history provided					Yes	
3.22.3	Details of improvements made in last 3 years provided					Yes	
3.22.4c	IED in-service experience as of tender closing				eq.yrs	> 50	
3.23	Marking, labelling and packaging						
	Requirements as per specification					Noted	
3.23.2	LED/push button labels slide behind clear screen					Yes	
3.24	Spares						
3.25	Repairs						
3.25.1	Repair turnaround time					Specify	
4.1	General				Schedule A		Schedule B
4.1.4	Type testing laboratory				Specify		
4.1.4	SANS/ILAC accreditation of laboratory				Specify		
4.2	Type Tests (per IED product family)						
	Test	Standard	Ports*	Compliance criteria			
-	Manufacturer product family/series name				Specify		
4.2.1	Product Safety						
1(a)	Dielectric withstand	IEC 60255-5	-	2kV r.m.s. 50Hz for 1 minute between all terminals to case earth, 1kV across contacts.	Comply		
1(b)	Insulation resistance	IEC 60255-5	-	Insulation resistance greater than 20MΩ when measured at 500Vd.c.	Comply		

ESKOM COPYRIGHT PROTECTED

**DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR
SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE**Unique Identifier: **240-105506460**Revision: **1**Page: **102 of 107**

1(c)	Electrical impulse (1.2/50µs)	IEC 60255-5	-	5kV 1.2/50µs waveform, 0.5J	Comply	
2	Enclosure protection	SANS 60529	ENC	Protected against ingress of dust particles, dripping water.	IP41 (front panel)	
				Protected against access to hazardous parts with the back of a hand.	IP1X (rear)	
4.2.2	Environmental specifications					
1	Cold	IEC 60068-2-1	-	16 hours at -25°C (LCD screen operative)	-25°C Test Ad	
2	Dry Heat	IEC 60068-2-2	-	16 hours tolerance at +55°C/+70°C (control room / outdoor application)	+55°C / +70°C Test Bd	
3	Cyclic Temperature and Humidity	IEC 60068-2-30	-	25°C and 95% relative humidity/ 55°C and 95% relative humidity, 12 + 12 hour cycle	+55°C Test Db	
4	Vibration	IEC 60255-21-1	-	Response: 1g, 10 - 150Hz, 1 sweep, energised. Contacts should not close for longer than 2ms.	Class Response 2	
			-	Endurance: 1g 10 – 150Hz, 20 sweeps, un-energised. Contacts should not close for longer than 2ms.	Class Endurance 1	
5	Shock	IEC 60255-21-2	-	Response: 5g, 11ms, 3 pulses in each direction, energised	Class 1 Response	
			-	Withstand: 15g, 11ms, 3 pulses in each direction, un-energised	Class 1 Withstand	
6	Bump	IEC 60255-21-2	-	10g, 16ms, 1000 pulses un-energised.	Class 1	
7	Seismic	IEC 60255-21-3	-	Test method A (single axis sine sweep test) 1 – 35Hz, 1 sweep.	Class 1	

ESKOM COPYRIGHT PROTECTED

TECHNICAL SCHEDULES A & B FOR

SWITCHGEAR PIUs IN ACCORDANCE WITH EST 240-64685228

Type Tests per IED product family (concluded)

4.2.3	Immunity Specifications					
Note: Refer to IEC 60255-26 for an overview of electromagnetic compatibility requirements.						
1(a) - (c)	Voltage dips, interruption, gradial start-up/shut-down	IEC 60255-11	PS	50ms interruption has no effect on operation No maloperation for 5s interruption. No maloperation for decaying DC over 60s, rising over 60s.	Comply	
1(d)	AC ripple	IEC60255-11	PS	Device shall function correctly with 12% 100Hz ac signal superimposed on the d.c. supply.	Comply	
4.2.3	Immunity Specifications (Continued)					
2	Power frequency magnetic field	SANS 61000-4-8	ENC	100A/m continuous, 1000A/m 1-3s, 50Hz	Class 5	
3	1MHz oscillatory waves	IEC60255-22-1 or SANS 61000-4-18	PS, IO	2.5kV CM, 1kV DM, 2s total test duration, 6 – 10 bursts at 400Hz repetition.	Class 3	
			COM	1kV CM, 0kV DM, 2s total test duration, 6 – 10 bursts at 400Hz repetition.		
4	Electrostatic Discharge	IEC 60255-22-2 or SANS 61000-4-2	ENC	6kV Contact Discharge, 8kV Air Discharge	Class 3	
5	Radiated Radio Frequency field	IEC 60255-22-3 or	ENC	10V/m unmod r.m.s., 80% AM (1kHz), 80MHz – 1GHz, 1.4 – 2.7 GHz	-	
		SANS 61000-4-3			Class 3	
6	Fast Transient	IEC 60255-22-4	PS, IO, E	2kV, 5kHz	Class B	
			COM	1kV, 5kHz		

7	Surge	IEC 60255-22-5 or		1,2/50μs (8/20μs) voltage (current) surge:	-	
			PS, IO	0,5; 1; 2 kV line to earth, 0,5; 1 kV line to line		
			COM	0,5; 1 kV line to earth		
		SANS 61000-4-5	PS, IO	2kV	Class 3	
8	Induced Radio Frequency field	IEC 60255-22-6 or	PS, COM, IO, E	10Vrms, 150kHz – 80MHz	-	
		SANS 61000-4-6			Class 3	
9	Power Frequency immunity	IEC 60255-22-7	IO	AC voltages applied to D.C. inputs: 150V r.m.s. DM, 300V r.m.s. CM	Class A	
4.2.4	Emission Specifications					
Note: Refer to IEC 60255-26 for an overview of electromagnetic compatibility requirements.						
1	Conducted emission	IEC 60255-25	PS	0,15 – 0,5 MHz: 79dB(μV) quasi peak, 66dB(μV) ave.	-	
				0,5 – 30 MHz: 73dB(μV) quasi peak, 60dB(μV) ave.		
2	Radiated emission	IEC 60255-25	ENC	30 – 230 MHz: 40dB(μV) quasi peak at 10m	-	
				230 – 1000 MHz: 47dB(μV) quasi peak at 10m		

* Immunity and Emission tests are applicable to specific “ports” of the Equipment Under Test:-

COM: (Rear) communication ports; E: Earth terminal; ENC: Device enclosure; IO: Inputs/Outputs; PS: Power Supply

CM = Common Mode, DM = Differential Mode.

Annex D – Maintenance Analysis

Below is the table with the FMECA required details that shall be completed and submitted with the tender documentation by the supplier. This shall have the headings of each column as shown below.

The supplier shall provide the details of the maintenance analysis (Table 1A: FMECA sheet) to indicate the reasoning as to the identified maintenance activities and logistics requirements. Note that a criticality assessment may have to be included for each Functional Importance, Health, Usage or Environment row that is included in Table: Maintenance Requirements Definition, if the Consequence or Probability is dependent on these. The supplier shall complete the shaded areas.

The supplier shall also complete the shaded areas of the maintenance requirements definition (Table 1B). The maintenance requirements are defined based on the activities identified from the FMECA and RCM (if included) and taking criteria, associated with the actual functional location, into consideration. This results in several possible maintenance requirement permutations, one of which will be selected by the maintenance function for any item of plant, and from which a consolidated maintenance plan can then be developed.

DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR SYSTEM NOMINAL VOLTAGES 66KV AND ABOVE

Page: 106 of 107

[illegible]

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

Document Classification: Controlled Disclosure

DISCONNECTING CIRCUIT-BREAKERS (DCB) FOR SYSTEM NOMINAL VOLTAGES 66KV
AND ABOVE

Unique Identifier: 240-105506460
Revision: 1
Page: 107 of 107

Table D.15: Maintenance Requirements Definition

Equipment Class:		Breaker																																					
Equipment Sub Class:		SF6																																					
Equipment Sub Class Family:		ABC																																					
Trigger Modifiers	Functional Importance	Options	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32		Key			
		Critical																			X	X	X	X	X	X	X	X	X	X	X	X	X	1M		One monthly			
		Significant										X	X	X	X	X	X	X	X		X	X	X	X	X											6M	Once every six months		
		Economic										X	X	X	X	X	X	X	X																		1Y	Once every year	
	Usage / Duty Cycle	Run to fail	X	X	X	X	X	X	X	X																											2Y	Once every two years	
		High			X	X			X	X			X	X			X	X			X	X				X	X			X	X			X		X	3Y	Once every three years	
	Environment	Low	X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X				X	X	4Y	Once every four years
		Harsh		X		X		X			X		X		X	X			X	X			X	X			X	X			X	X							
	Health	Mild	X	X	X	X		X		X		X	X	X	X			X	X		X	X	X	X		X	X	X	X		X	X		X		X			
		Very Good / Good	X	X	X	X						X	X	X	X					X	X	X	X			X	X	X	X										
		Fair / Poor / Very Poor					X	X	X	X					X	X	X	X					X	X	X	X													
Maintenance Tasks		FMECA Ref No	Trigger ¹ (Time and/or Condition)																													Outage Y/N	Manual Y/N	Maintenance Activities					
Condition Monitoring																																							
Inspection or Test Task 1...n																																							
Preventive Maintenance based on Time																																							
Maintenance Task 1...n																																							
Preventive Maintenance based on Condition																																							
Maintenance Task 1...n																																							
Corrective Maintenance:																																							
Maintenance Task 1...n																																							
Statutory Maintenance																																							
Maintenance Task 1...n																																							

ESKOM COPYRIGHT PROTECTED

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