Eskom	Standard	Technology

Title: **DISTRIBUTION GROUPS SPECIFIC REQUIREMENTS FOR 132KV MIXED TECHNOLOGY GAS INSULATED SWITCHGEAR STANDARD**

Unique Identifier: **240-56030436**

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

Area of Applicability: **Engineering**

Next Review Date: **STABILISED**

COE Acceptance

Bheki Ntshangase

Senior Manager Substation Equipment & Diagnostics, Transmission

Date: 9/04/2021

DBOUS Acceptance

Amelia Mtshali

Senior Manager DBOUS, Distribution

Date: 09/04/2021

This document is **STABILISED.** The technical content in this document is not expected to change because the document covers: *(Tick applicable motivation)*

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

PCM Reference: **240-53459006**

SCOT Study Committee Number/Name: **Plant Equipment Study Committee**

Eskom	Standard	Technology

Title: **DISTRIBUTION GROUPS SPECIFIC REQUIREMENTS FOR 132KV MIXED TECHNOLOGY GAS INSULATED SWITCHGEAR STANDARD**

Unique Identifier:	**240-59030436**
Alternative Reference Number:	**34-378**
Area of Applicability:	**Engineering**
Documentation Type:	**Standard**
Revision:	**3**
Total Pages:	**85**
Next Review Date:	**May 2020**
Disclosure Classification:	**Controlled Disclosure**

Compiled by	Approved by	Authorized by
Sphiwe Nkosi	**Andre Marais**	**Bheki Ntshangase**
PDE HV Plant	**GIS/ MTS CG Convener**	**Senior Manager HV Plant**
Date: 20/05/2015	Date: 21/05/2015	Date: 25/05/2015

Supported by SCOT/SC

Bheki Ntshangase

Plant Equipment SC Chairperson

Date: 25/05/2015

PCM Reference: **240-53459006**

SCOT Study Committee Number/Name: **Plant Equipment Study Committee**

Content

Figures

Tables

1. Introduction

This standard sets out Eskom's specific and standardized requirements for outdoor Mixed Technology Switchgear (MTS) for use in three-phase 50 Hz Alternating Current (AC) systems with nominal voltages up to and including 132 kV. The requirements for MTS are based on [22] SANS 62271-205 (compact switchgear assemblies for rated voltages above 52 kV). The standard covers switchgear assemblies containing a combination of Air-insulated Switchgear (AIS) and Gas-insulated Switchgear (GIS) – so-called MTS of the 'hybrid', dead-tank compact design.

The Mixed Technology Switchgear designs that offer environmental friendliness and meet this standard shall be considered. These shall have been designed and type tested in accordance with on [22] SANS 62271-205 (compact switchgear assemblies for rated voltages above 52 kV).

NOTE:

Reference [22] SANS 62271-205 defines a compact switchgear assembly as an assembly consisting of at least one switching device directly connected to, or sharing components with, one or more other devices such that there is an interaction between the functions of the individual devices. Interaction is the transfer of stresses (e.g. electrical, mechanical and thermal) between the individual devices. A compact switchgear assembly may be mounted on one or more structures, but it is only intended for installation and operation as a single, complete unit.

Reference [22] SANS 62271-205 describes MTS as switchgear assemblies which incorporate a mixture of the insulating characteristics of both AIS and GIS and/or which implement traditionally discrete functions (devices) in a compact and/or combined design in such a way that they can no longer be considered for the purposes of design and testing, in isolation.

2. Supporting clauses

2.1 Scope

This standard provides the specific and standardized requirements for outdoor Mixed Technology Switchgear (MTS) of the 'hybrid', dead-tank compact design in accordance with [22] SANS 62271-205. The switchgear is intended for use in substations having three-phase 50 Hz Alternating Current (AC) nominal operating voltages up to and including 132 kV. The compact switchgear assembly circuit-breaker is required for general-purpose (i.e. transformer, feeder and bus-section/coupler) power switching and protection applications. This includes the standard outdoor substation, mobile substation and indoor substation installations. The standard standardizes the arrangement of the various devices included in the MTS, namely circuit-breakers, combined disconnector/earthing switches, Current Transformers (CTs), bushings and external conductor/ cable/transformer connections.

The Mixed Technology Switchgear designs that offer environmental friendliness and meet this standard shall be considered. These shall have been designed and type tested in accordance with on [22] SANS 62271-205 (compact switchgear assemblies for rated voltages above 52 kV).

A set of Technical Schedules A and B accompanies this standard. Additional and special requirements may also be included in Schedule A.

The standard covers the design, manufacture, testing, supply, delivery, storage, installation, pre-commissioning and guarantee of the switchgear and control gear specified herein.

This standard includes the requirement for the full detailed [51] maintenance analysis FMECA. It also includes the option of the digital secondary plant interface [50].

2.1.1 Purpose

None

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

[1] IEC 60073 Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators

[2] IEC 60376 Standard of technical grade sulphur hexafluoride (SF6) for use in electrical equipment

[3] IEC 60447 Basic and safety principles for man-machine interface, marking and identification – Actuating principles

[4] NRS 029 Current transformers for rated a.c. voltages from 3,6 kV up to and including 420 kV (maximum voltage for equipment

[5] NRS 087 Guidelines for the purchase use and disposal of SF6

[6] SANS 1091 National colour standard

[7] SANS 60044-1 Current Transformers

[8] SANS 60060-1 High-voltage test techniques — Part 1: General definitions and test requirements

[9] SANS 60137 Insulated bushings for alternating voltages above 1 000 V

[10] SANS 60529 Degrees of protection provided by enclosures (IP code)

[11] SANS 60815-1 Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles

[12] SANS 60815-2 Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 2: Ceramic and glass insulators for a.c. systems

[13] SANS 60815-3 Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems

[14] SANS 61243-5 Live working – Voltage detectors Part 5: Voltage detecting systems (VDS)

[15] 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

[16] SANS 62271-1 High-voltage switchgear and control-gear – Part 1: Common standards

[17] SANS 62271-100 High-voltage switchgear and control-gear – Part 100: High-voltage alternating-current circuit-breakers

[18] SANS 62271-102 High-voltage switchgear and control-gear – Part 102: Alternating current disconnectors and earthing switches

[19] SANS 62271-203 High-voltage switchgear and control-gear – Part 203: Gas-insulated metal-enclosed switchgear for rated voltages above 52 kV

[20] SANS 62271-209 High-voltage switchgear and control-gear – Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV – Fluid-filled and extruded insulation cables – Fluid-filled and dry-type cable-terminations

[21] SANS 62271-301 High-voltage switchgear and control-gear – Part 302: Dimensional standardisation of high-voltage terminals

[22] SANS 62271-205 High-voltage switchgear and control-gear - Part 205: Compact switchgear assemblies for rated voltages above 52 kV

[23] DPC 34-214 Distribution Standard Part 0: KIPTS natural ageing and pollution performance test procedure for outdoor insulator products section 0 – particular requirements for through-wall bushings

[24] 240-56062328 KIPTS Natural Ageing and Pollution Performance Test Procedure for Outdoor Insulator Products Section 0 - General Requirements Work Instruction

[25] 240-56062515 Labels on Control Panels, Relay Panels and Other Indoor and Outdoor Equipment Standard

[26] DSP 34-1658 Distribution Standard Part 4: Corrosion protection standard for new indoor and outdoor Distribution equipment manufactured from steel

[27] 240-56065202 Switchgear Training Requirements from Original Equipment Manufacturers Standard

[28] 240-56030489 Requirements for Wiring of Outdoor Circuit Breakers up to and Including 132kV Standard

[29] 240-56063765 Eskom Health and Safety Management Supplier Requirement Standard

[30] QM-58 Supplier Contract Quality Requirements Specification

[31] Occupation Health and Safety Act (OHS Act) No 85 of 1993 – Construction and Electrical Machinery Regulations

[32] ESP 32-846 Operating Regulations for High Voltage Systems (ORHVS)

[33] Appendix B – Technical schedules

[34] D-DT-5047 [Sheets 2 & 4] Fibreglass label type 2 size and manufacturing details

[35] D-DT-5409 Wiring of mixed technology switchgear up to and including 132 kV

[36] D-DT-6081 Ball joint assembly for use on portable earthing

[37] IEC 61850/ SANS 61850 (All parts) Communication networks and systems for power utility automation

[38] SANS 62271-3/ IEC 62271-3 High-voltage switchgear and controlgear — Part 3: Digital interfaces based on IEC 61850

[39] 240-42066934 IEC61850 Protocol implementation document for the purposes of substation automation

[40] 240-64685228 Generic specification for protective Intelligent Electronic Devices (IEDs)

[41] 240-68107841 Eskom IEC61850 standard requirements for PICS, PIXIT and TICS

[42] 240-68235024 Eskom IEC61850 station bus interoperability test standard

[43] 240-70413291 Specification for electrical terminal blocks

[44] 240-64636794 Generic equipment standard for wiring, wire marking and cable numbering

[45] SANS 62271-110 High-voltage switchgear and control-gear – Part 110: Inductive load switching

2.2.2 Informative

[46] 32-9 Definition of Eskom Documents

[47] 32-644 Eskom Documentation Management Standard

[48] 474-65 Operating Manual of the Steering Committee of Wires Technologies (SCOWT)

[49] Appendix A – Supplier and Eskom’s responsibilities

[50] Appendix B – Technical Schedules

[51] Appendix C – Technical Schedules for the digital secondary plant interface

[52] Appendix D – Maintenance Analysis

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 control-gear to an acceptable condition after a failure.
EARTH position	State of a compact switchgear assembly in which a main circuit is short-circuited and earthed. NOTE: In a functional unit incorporating a circuit-breaker and disconnector/earthing switch, the EARTH position would require the earthing switch to be in the earthing position and the circuit-breaker in the closed position.
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].
Major maintenance (overhaul)	Work performed with the objective of repairing or replacing parts which are found to be out of tolerance by inspection, test, examination, or as required by manufacturer's maintenance manual, in order to restore the component and/or the switchgear and control-gear to an acceptable condition (within tolerance). **Notes**: 1) This is the definition of 'overhaul' given in 3.1.11 of [16] SANS 62271-1. 2) Major maintenance involves the execution of specialized maintenance where specialized knowledge and skills are required and is also sometimes referred to as specialized maintenance.
Minor maintenance	The execution of scheduled or preventive maintenance work in accordance with the manufacturer's maintenance manual and requiring the switchgear and control-gear to be taken out of service (i.e. in a down state). NOTE: Observations resulting from minor maintenance can lead to the decision to carry out an overhaul. Scheduled maintenance is defined in 3.1.7 of [16] SANS 62271-1. Minor maintenance may be time-based and/or condition-based. Minor maintenance may also include circuit-breaker examination (refer to 3.1.10 of [16] SANS 62271-1) with diagnostic tests (refer to 3.1.9 of [16] SANS 62271-1). Minor maintenance may also be referred to as second line maintenance.
OFF position	State of a compact switchgear assembly in which a main circuit is disconnected (isolated) from the busbar. NOTE: In a functional unit incorporating a circuit-breaker and disconnector/earthing switch, the OFF position would require both the circuit-breaker and disconnector to be in their respective open positions.
ON position	State of a compact switchgear assembly in which a main circuit is connected to the busbar. Note: In a functional unit incorporating a circuit-breaker and disconnector/earthing switch, the ON position would require both the circuit-breaker and disconnector to be in their respective closed positions.

Definition	Description
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.
Routine inspection	Visual investigation of the principal features of the switchgear and control-gear in service without dismantling. NOTE: 1) This inspection is generally directed toward pressures and/or levels of fluids, tightness, position of relays, pollution of insulating parts, but actions such as lubricating, cleaning and washing, which can be carried out with the switchgear and control-gear in service, are also included. 2) Observations resulting from inspection can lead to the decision to carry out an overhaul. 3) As indicated in note 1, routine inspection may include scheduled maintenance activities in accordance with the manufacturer's maintenance manual. 4) Routine inspection may also be referred to as first line maintenance. 5) This is the definition of 'inspection' given in 3.1.8 of [16] SANS 62271-1.
Specialized tools	Any purpose-built tools necessary to carry out major (or specialized) 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
AC	Alternating Current [qualifier]
ACSI	Abstract Communication Service Interface [IEC 61850-7-2]
AIS	Air-insulated Switchgear
AMSL	Above Mean Sea Level
BOM	Bill of Materials
CAP	Committee for Accepted Products
CD	Compact Disc
CMT	Compact Mixed Technology
CT	Current Transformer
DC	Direct Current [qualifier]
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
DS	Detailed Standard

Abbreviation	Description
DVD	Digital Versatile Disc
EMC	Electromagnetic Compatibility
FAS	Fall Arrest System
FAT	Factory Acceptance Testing
FMECA	Failure Modes, Effects and Criticality Analysis
GA	General Arrangement
GIS	Gas-insulated Switchgear
GM	General Manager
GOOSE	Generic Object Oriented Substation Event [IEC 61850-8-1]
HV	High Voltage
IARC	Industry Association Resource Centre (formerly 'Distribution Technology')
IEC	International Electro technical Commission
IP	International Protection
KEMA	Keuring van Electrotechnische Materialen
KIPTS	Koeberg Insulator Pollution Test Station
LAP	List of Accepted Products
LV	Low Voltage
M	Metering
MCB	Miniature Circuit-breaker
MIB	Marshalling Interface Box
MSDS	Material Safety Data Sheets
MTS	Mixed Technology Switchgear
n/a	not applicable
OEM	Original Equipment Manufacturer
OHS	Occupational Health and Safety
OU	Operating Unit
P	Protection
PDF	Portable Document Format
PPE	Personal Protective Equipment
rms	root mean square
SABS	South African Bureau of Standards
SANAS	South African National Accreditation System
SC	Study Committee
SCD	Specific Creepage Distance
SCOT	Steering Committee of Technologies

Abbreviation	Description
USCD	Unified Specific Creepage Distance
VDS	Voltage Detection System

2.5 Roles and responsibilities

Document to be reviewed by PDE HV Plant Specialist.

2.6 Process for monitoring

Not applicable

2.7 Related/supporting documents

Not applicable

3. Distribution Groups Specific Requirements for 132kV Mixed Technology Gas Insulated Switchgear

3.1 Ratings

NOTE: For ease of reference, where possible, the paragraph numbering used in this section corresponds to that of [22] SANS 62271-205 and [17] SANS 62271-100.

3.1.1 Rated voltage (U_r) and number of phases

a) The rated voltage of compact switchgear assembly shall be in accordance with the values given in 1 below. The rated voltage required will be specified in Schedule A. The rated voltage offered shall be stated in Schedule B.

NOTE: The nominal high-voltage system voltages (U_n) in Eskom are 44 kV, 66 kV, 88 kV and 132 kV.

b) The number of phases shall be three.

3.1.2 Rated insulation levels

The rated insulation levels of compact switchgear assembly shall be in accordance with the values given in 1 below. The rated insulation levels offered shall be stated in Schedule B. No additional altitude correction factors need be applied for equipment installed up to 1 800 m Above Mean Sea Level (AMSL).

Table 1: Rated Voltage and Insulation Levels

Nominal system voltage U_n (kV (rms))	Rated voltage U_r (kV (rms))	Rated short-duration power-frequency withstand voltage U_d (kV (rms))		Rated lightning impulse withstand voltage U_p (kV (peak))		Rated switching impulse withstand voltage U_s (kV (peak))	
		Common value	Across the isolating distance	Common value	Across the isolating distance	Common value	Across the isolating distance
44 & 66	72,5	140	160	350	375	-	-
88 & 132	145	275	315	650	750	-	-

NOTE:

a) In this table, the withstand voltages apply at the standardized reference atmosphere (temperature, pressure and humidity) in accordance with [16] SANS 62271-1.

b) The information in this table is based on SANS 1019 and [16] SANS 62271-1.

c) The standard 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. This enables manufacturers and users to adopt internationally accepted designs for use in South Africa.

d) No additional altitude correction factors need be applied for equipment installed up to 1 800 m AMSL. Switchgear rated 24 kV, having a 145 kV lightning impulse withstand voltage insulation level in accordance with IEC 60071-1, will be accepted.

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 compact switchgear assembly shall be 2 500 A. The rated normal current offered shall be stated in Schedule B.

NOTE: In special requirements, Eskom shall specify the rated normal current of 3 150 A. This shall be stated on the Schedule B.

b) The associated temperature rise limits for the rated normal current shall be in accordance with [16] SANS 62271-1.

c) Based on the actual results of the compact switchgear assembly temperature rise type testing, the calculated maximum continuous current that the circuit-breaker can carry, without exceeding the maximum allowable temperatures for the major components, shall be stated in Schedule B for a maximum ambient temperature of (a) 40 °C and (b) 45 °C (refer to 3.2.1).

d) Based on the actual results of the compact switchgear assembly temperature rise type testing, the highest measured temperature rise values for the major components (refer to [16] SANS 62271-1 table 3) when carrying rated current shall be stated in Schedule B.

3.1.5 Rated short-time withstand current (I_k)

a) The rated short-time withstands current of compact switchgear assembly shall be in accordance with the values given in 2. 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.

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 circuit-breaker exceeds the same three-phase rating will be specified in schedule A. The factor offered shall be stated in schedule B. This current shall be included on the nameplate.

3.1.6 Rated peak withstand current (I_p)

The rated peak withstands current of compact switchgear assembly shall be in accordance with the values given in 2 below. The rated peak withstand current required will be specified in Schedule A. The rated peak withstand current offered shall be stated in Schedule B.

NOTE: A multiplying factor of 2,5 has been used based on a standard system Direct Current (DC) time constant of 45 ms.

3.1.7 Rated duration of short circuit (t_k)

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

Table 2: Standardized Rated Short Circuit-Breaking, Short-Time and Peak Withstand Currents

Nominal system voltage U_n (kV)	Rated short-circuit breaking and short-time (3 s) withstand current I_{SC}, I_k (kA (rms))	Rated peak withstand current I_p (kA (peak))
44 & 66	31,5	78,75
88 & 132	40	100

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

a) The rated DC supply voltage (Ua) of closing and opening devices and of auxiliary and control circuits shall be 110 V or 220 V. The rated DC supply voltage required will be specified in Schedule A.

b) The rated AC supply voltage (Ua) of heaters and other AC auxiliary circuits shall be single-phase 230 V.

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

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

NOTE: For ease of reference, where possible, the paragraph numbering used in this section corresponds to that of [22] SANS 62271-205 and [17] SANS 62271-100.

3.1.10 Rated short-circuit breaking current (I_{SC}) of the circuit-breaker

The rated short-circuit breaking current (I_{SC}) of circuit-breakers shall be equal in value to the rated short-time withstand current (I_k) specified in 2. 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.

3.1.11 Transient recovery voltage related to the rated short-circuit breaking current of circuit-breakers

a) The first-pole-to-clear factor (k_{pp}) for circuit-breakers used in systems of nominal voltage up to and including 132 kV shall be 1,5 in accordance with [17] SANS 62271-100, i.e. as applicable to circuit-breakers used in non-effectively earthed systems.

NOTE: 44 kV to 132 kV networks are usually solidly earthed. However, in the interests of standardization, 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 [17] SANS 62271-100 shall apply according to the circuit-breaker class specified in 3 for the relevant circuit-breaker application and as defined in [17] SANS 62271-100.

3.1.12 Rated short-circuit making current of circuit-breakers

The rated short-circuit making current of circuit-breakers shall be equal in value to the rated peak withstand current specified in 2. 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.

3.1.13 Rated operating sequence for circuit-breakers

a) The following rated operating sequence shall apply to all three-pole operated circuit-breakers intended for rapid auto-reclosing (i.e. compact switchgear assembly required for feeder applications). The rated operating sequence required will be specified in Schedule A.

b) 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 circuit-breakers offered with a rated operating sequence where t' = 15 s.

c) The following rated operating sequence shall apply to all 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 circuit-breaker's rated characteristics, following the rated operating sequence under the most unfavourable conditions, shall be stated in Schedule B.

e) All 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.

3.1.14 Characteristics for short-line faults

These characteristics are applicable to class S2 circuit-breakers (refer to 3) intended for direct connection to overhead lines in systems with a solidly earthed neutral and all circuit-breakers having a rated voltage of 100 kV and above. They are therefore applicable to all circuit-breakers for use in systems of nominal voltage ≥ 44 kV. Refer to 4.105 of [17] SANS 62271-100 for standardized characteristics for short-line faults.

NOTE: 44 kV to 132 kV networks are usually solidly earthed.

3.1.15 Rated out-of-phase making and breaking current for circuit-breakers

The rated out-of-phase breaking current required will be specified in Schedule A in accordance with 4.106 of [17] SANS 62271-100. The rated out-of-phase making and breaking currents of the circuit-breaker offered shall be stated in Schedule B.

3.1.16 Rated capacitive switching currents for circuit-breakers

a) The classification of circuit-breakers according to their restrike performance for line- and cable-charging current switching shall be in accordance with 3 for the specified circuit-breaker application. The circuit-breaker 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 circuit-breakers shall be in accordance with the preferred values given in [17] SANS 62271-100.

3.1.17 Inductive load switching for circuit-breakers

No rating is assigned. Circuit-breakers shall be capable of switching shunt reactors and shall be designed to withstand re-ignitions. Refer to [45] SANS 62271-110 (applicable only to three-phase alternating current circuit-breakers having rated voltages of 52 kV and above). The chopping number of the circuit-breaker offered shall be stated in schedule B.

NOTES

- The use of controlled switching to provide re-ignition-free shunt reactor switching is recommended. Refer to **Error! Reference source not found.**. In the absence of controlled switching, re-ignitions during opening of the contacts cannot be avoided due to the random operation (opening) of the circuit-breaker. By means of controlled opening, all poles of the shunt reactor circuit-breaker 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 circuit-breaker.
- Information obtained from tests conducted in accordance with SANS 62271-110, i.e. the circuit-breaker chopping number (used to determine the suppression peak overvoltage factor) and the re-ignition behaviour, can be used to correctly configure the controller.
- The maximum ratings of existing (earthed) shunt reactors are typically 40 MVAr to 50 MVAr at 132 kV.

3.1.18 Rated time quantities for circuit-breakers

Refer to [17] SANS 62271-100. The rated opening time, break-time, closing time, open-close time, reclosing time, close-open time and pre-insertion time (where applicable) of the circuit-breaker offered shall be stated in Schedule B.

3.1.19 Mechanical endurance for circuit-breakers and disconnectors

The number of mechanical operations of circuit-breakers shall be in accordance with the mechanical endurance class specified in 3.1.20 below for the specified circuit-breaker application and as defined in [17] SANS 62271-100. The circuit-breaker class offered shall be stated in Schedule B.

The number of mechanical operations of disconnectors shall be in accordance with the mechanical endurance class specified in 3.1.20 and as defined in [18] SANS 62271-102. The disconnector class offered shall be stated in Schedule B.

3.1.20 Classification of circuit-breakers as a function of electrical endurance

The classification of circuit-breakers as a function of electrical endurance shall be in accordance with 3.1.20 for the specified circuit-breaker application. The circuit-breaker class offered shall be stated in Schedule B.

Table 3: Classification of Switching Devices ([17] SANS 62271-100 and [18] SANS 62271-102)

Compact switchgear assembly	Compact switchgear assembly application	Circuit-breaker class [a]	Circuit-breaker electrical endurance [b]	Re-strike performance during capacitive current breaking (line- and	Mechanical endurance of circuit-breaker	Mechanical endurance of disconnector [c]
66 kV, 31,5 kA	Transformer and Feeder (three-pole operated)	S2	n/a	C2	M2	M2
66 kV, 31,5 kA	Bus-section/ coupler (three-pole operated)	S2	n/a	C2	M2	M2
132 kV, 40 kA	Transformer and Feeder (three-pole operated)	n/a	n/a	C2	M2	M2
132 kV, 40 kA	Bus-section/ coupler (three-pole operated)	n/a	n/a	C2	M2	M2

NOTE:

a) Class S2 circuit-breakers (i.e. circuit-breakers intended to be used in line systems) are restricted to systems of rated voltages ≥ 15 kV and < 100 kV, in accordance with [17] SANS 62271-100. Class S2 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 MTS circuit-breakers are used in cable systems, for standardization purposes, class S2 circuit-breakers are suitable.

b) Class E1 and E2 circuit-breakers are restricted to distribution circuit-breakers of rated voltage up to and including 52 kV in accordance with [17] SANS 62271-100.

c) Class M2 disconnector is in accordance with [18] SANS 62271-102 standard Table 3a. The disconnector class that matches the circuit-breaker class shall be preferred. Only upon Eskom's discretion shall the disconnector of Class M1 be considered when the circuit-breaker of the compact switchgear assembly is rated for Class M2.

3.2 Design and construction

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. 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 circuit-breaker, 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 (refer to 3.5.4).

3.2.1 Service conditions

3.2.1.1 The normal service conditions for outdoor switchgear and control-gear specified in [16] SANS 62271-1 shall apply. The following additional specific requirements shall be taken into account:

i. A minimum ambient air temperature of -10 °C;

ii. A maximum ambient air temperature of +45 °C (refer to 3.1.4 c.);

iii. Rapid temperature changes. The condensation of water vapour can take place within operating mechanism enclosures and hollow components. The average humidity is 95 %;

iv. wind velocity of 34 m/s (N);

v. Solar radiation up to a level of 1 100 W/m^2 (on a clear day at noon);

vi. The circuit-breakers shall be installed up to altitudes of 1 800 m.

NOTE: Due (in part) to the fact that the switchgear and controlgear shall be used up to altitudes of 1 800 m AMSL, altitude-corrected insulation withstand levels are specified in this document. No further altitude correction factors are therefore required for altitudes above 1 000 m AMSL in accordance with [16] SANS 62271-1.

vii. The class of pollution characterizing the site severity will be specified in Schedule A in accordance with [11] SANS 60815-1 (e.g. class ‘e’ corresponding to ‘very heavy’).

viii. 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.

ix. Seismic activity up to 0,3 g.

3.2.1.2 Compact switchgear assembly 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.

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

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

- Access to the current transformers for primary injection testing;
- Method to temporarily disconnect and remove the compact switchgear assembly unit from the main circuit without interruption to the adjacent circuit;
- CT replacement method, without having to interfere with the SF6 circuit.
- Compliance to Eskom’s [4] NRS 029 specification
- Timing diagram and number of auxiliary contacts for disconnectors and earthing switches.
- Injection facility on the compact switchgear assembly unit when testing cables, without disconnecting.
- Full maintenance analysis FMECA of the compact switchgear assembly unit as per [51] Appendix D.

- Response to the Digital secondary plant interface option clauses 3.2.17.2 and 3.2.17.3 and [50] Appendix C.

3.2.2.1 The following are the requirements for the compact switchgear assembly unit design:-

a) Outdoor compact switchgear assembly shall comply with the requirements of [22] SANS 62271-205 and the requirements of this standard. Where conflicting requirements exist, the requirements of this standard shall take precedence.

b) Compact switchgear assembly shall be of the dead-tank design. The arrangement of devices shall be of a Type 3 design in accordance with [22] SANS 62271-205 and shall have CT's on both sides of the circuit-breaker interrupter and/ or compartment in-order to allow for safety of the personnel during onsite primary injecting and testing performed from ground level. This shall comply with the requirements of clause 3.2.2.1 n), provision of the a separate insulated copper connection from the earth switch to a junction box, mounted at ground level on the switchgear's steel support i.e. One earth lead per phase.

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 shall be submitted with the tender documentation and will be subject to approval by Eskom.

The following standardized arrangements of switching devices are applicable:

i. A Feeder compact switchgear assembly for a single busbar arrangement (refer to Figure 1, below) consists of one combined disconnector/ earthing switch (located on the busbar side of the circuit-breaker); current transformer cores, circuit-breaker, current transformer cores, and one combined disconnector / earthing switch (located on the line side of the circuit breaker) in accordance with D-DT 5409. An additional earthing switch shall be added on the line or cable side of the unit (refer to the highlighted part of the arrangement):-

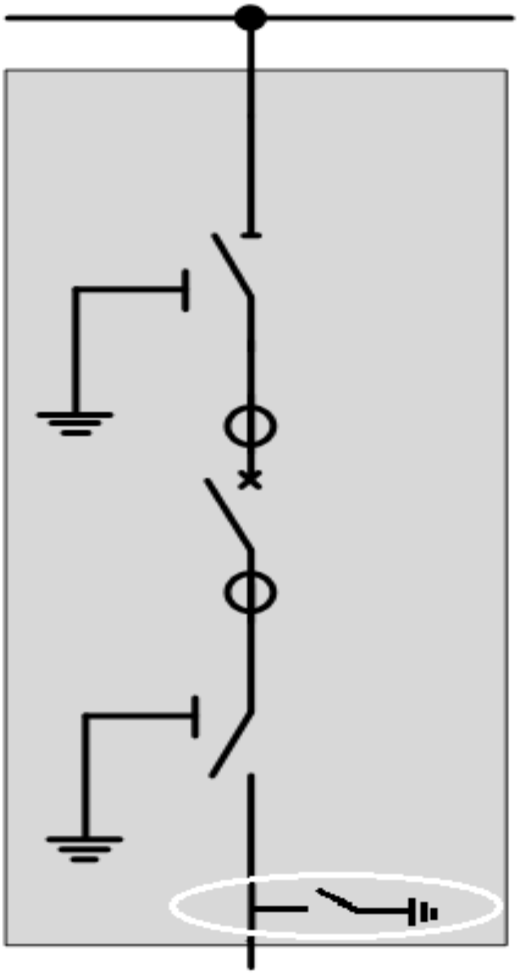

Figure 1: Arrangement of Devices in a Feeder Compact Switchgear Assembly for a Single Busbar Arrangement

The interlocking between the VDSs and the earthing switches shall be indicated on the GA and the wiring schematic diagram of the compact switchgear assembly.

The Busbar 1 disconnector and the Busbar 2 disconnetor shall be able to be closed at the same time for switching the bay between busbars during the busbar transfer/ changeover.

ii. A Transformer compact switchgear assembly for a single busbar arrangement (refer to Figure 2, below) consists of one combined disconnector/ earthing switch (located on the busbar side of the circuit breaker); current transformer cores, circuit breaker and current transformer cores (located on the transformer side of the circuit breaker) in accordance with D-DT 5409:-

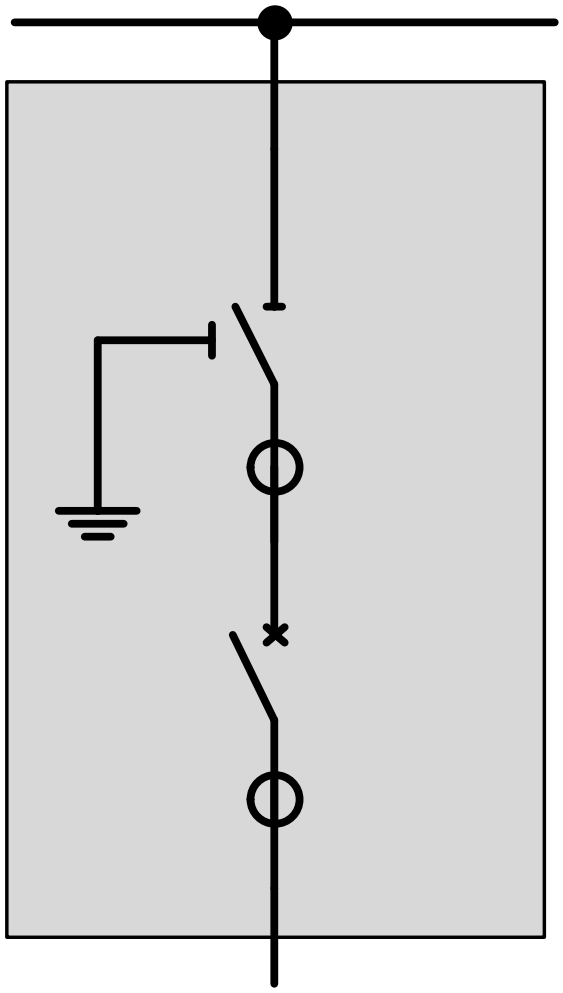

Figure 2: Arrangement of Devices in a Transformer Compact Switchgear Assembly for a Single Busbar Arrangement

iii. A Feeder compact switchgear assembly for a double busbar arrangement (refer to Figure 3, below) consists of the two modules of the combined disconnector/ earthing switch that are separate and parallel on the busbar side of the circuit-breaker; current transformer cores, circuit-breaker, current transformer cores, and one combined disconnector / earthing switch (located on the line side of the circuit breaker) in accordance with D-DT 5409. An additional earthing switch shall be added on the line or cable side of the unit (refer to the highlighted part of the arrangement):-

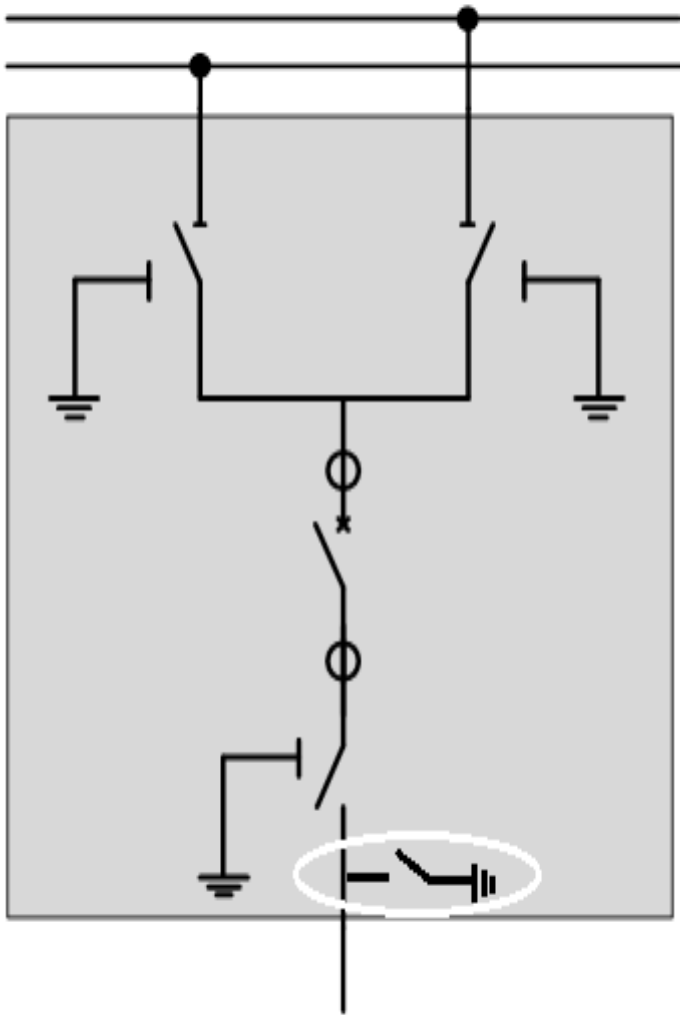

Figure 3: Arrangement of Devices in a Feeder Compact Switchgear Assembly for a Double Busbar Arrangement

The interlocking between the VDSs and the earthing switches shall be indicated on the GA and the wiring schematic diagram of the compact switchgear assembly.

The interlocking between disconnector/ earthing switch in the earth position of the one busbar and the that of the disconnector/earthing switch of the other busbar in the disconnector close position shall be provided.

The busbar 1 disconnector and the busbar 2 disconnetor shall be able to be closed at the same time for switching the bay between busbars during the busbar transfer/ changeover.

iv. A Transformer compact switchgear assembly for a double busbar arrangement (refer to Figure 4, below) consists of the two modules of the combined disconnector/ earthing switch that are separate and parallel on the busbar side of the circuit-breaker;; current transformer cores, circuit-breaker and current transformer cores (located on the transformer side of the circuit breaker) in accordance with D-DT 5409:-

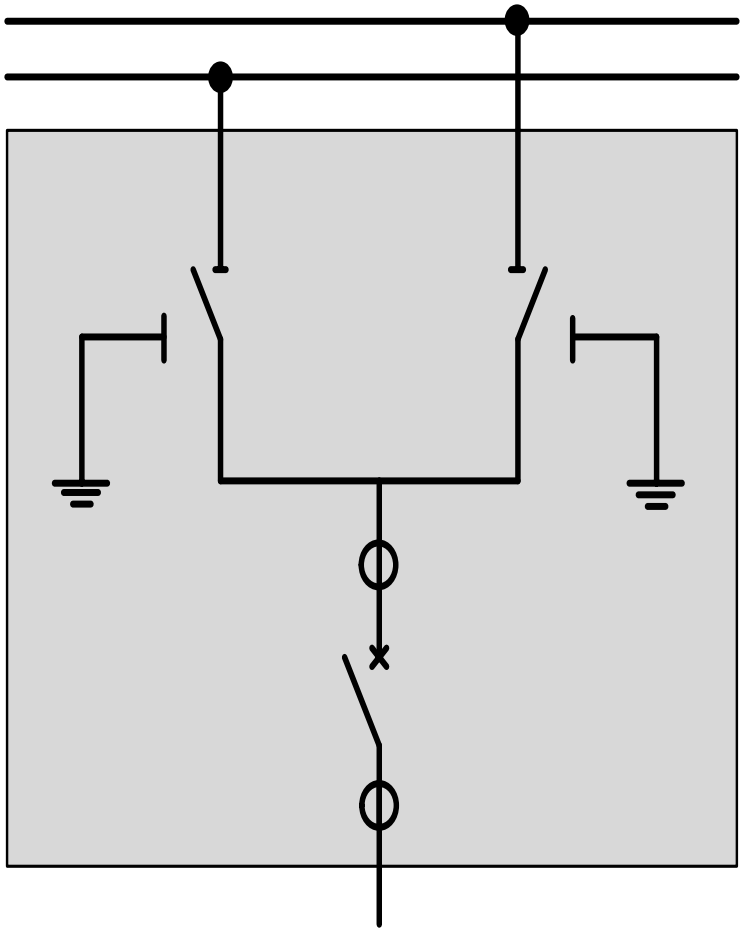

Figure 4: Arrangement of Devices in a Transformer Compact Switchgear Assembly for a Double Busbar Arrangement

The interlocking between disconnector/ earthing switch in the earth position of the one busbar and the that of the disconnector/earthing switch of the other busbar in the disconnector close position shall be provided.

v. A bus-section/coupler compact switchgear assembly (refer to Figure 5, below) – consisting of one combined disconnector/ earthing switch (located on the one end of the circuit breaker); current transformer cores, circuit-breaker, current transformer cores, and one combined disconnector / earthing switch (located on the opposite end of the circuit breaker) in accordance with D-DT 5409:-

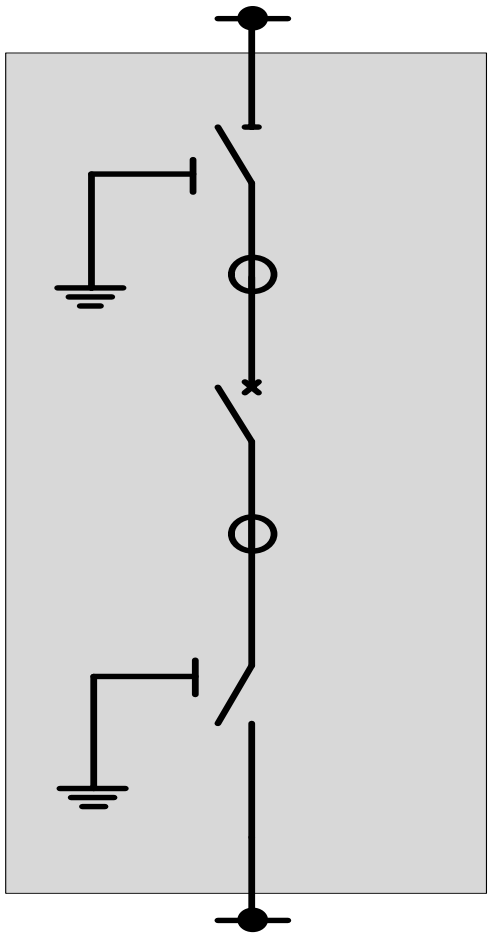

Figure 5: Arrangement of Devices in a Bus-Section/Coupler Compact Switchgear Assembly

c) Compact switchgear assembly shall be supplied complete with all the necessary components for the assembly. The steel support structure shall be supplied with the compact switchgear assembly.

NOTE: For further information relating to the supplier's and Eskom's scope of responsibility, refer to Appendix A.

d) The compact switchgear assembly insulating medium shall be stated in Schedule B. Compact switchgear assembly shall be designed for minimal maintenance in accordance with the electrical and mechanical endurance class applicable (refer to 3). The minimum expected lifespan shall be 40 years. Premature failures experienced in service of similar design compact switchgear assembly 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 3.2.20 n).

e) Circuit-breakers shall comply with the requirements of [17] SANS 62271-100 and the requirements of this standard.

f) Circuit-breaker operating mechanisms

i. Circuit-breakers shall be three-pole ('3P') operated (i.e. single operating mechanism).

NOTE: Upon Eskom specifying the switchgear assembly rated for the normal current rating of 3 150A, these shall be offered in both options of "1P" operated (i.e. 3 operating mechanisms) and "3P" operated (i.e. single operating mechanism).

ii. Circuit-breakers shall be designed for stored energy operation where energy is stored in a spring, unless otherwise approved by Eskom. It shall be possible to charge the circuit-breaker 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.

NOTE 1: Hydraulic operated or pneumatic operated mechanisms will not be accepted.

NOTE 2: When a feeder circuit-breaker 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.

g) The circuit-breaker operating mechanism 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 circuit-breaker.

h) The insulation and/or extinguishing medium of the circuit-breaker 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 circuit-breakers, the type of interrupter design (e.g. puffer, self-blast.) as well as the configuration of the moving contacts (e.g. single, double or triple motion design) shall be stated in Schedule B.

NOTE: For The Mixed Technology Switchgear designs that offer environmental friendliness and meet this standard shall be considered. These shall have been designed and type tested in accordance with on [22] SANS 62271-205 (compact switchgear assemblies for rated voltages above 52 kV).

i) Disconnector/earthing switches shall comply with the requirements of [18] SANS 62271-102 and the requirements of this standard. The type of disconnector offered (e.g. three-position disconnector) shall be stated in Schedule B.

j) Interlocking (including padlocking) devices in accordance with [19] SANS 62271-203 shall be provided on all compact switchgear assemblies. Interlocking devices between switching devices shall be mechanical. An interlock (preferably mechanical, minimum electrical) is required between the disconnector and the circuit-breaker. In addition, the interlock should be intelligent enough to allow for both safety aspects and accommodate maintenance.

k) All padlocking facilities shall be suitable for padlocks that have a shackle diameter of 6 mm.

l) In the case of double busbar compact switchgear assembly, gas-tight insulating partitions shall be provided to divide each switching device into functionally separate gas compartments. In the case of a fault inside one disconnector compartment, the functionality of the other disconnector compartment shall not be affected.

NOTE: For single busbar compact switchgear assemblies, switching devices housed in a combined gas compartment may be accepted.

m) Gas-filled enclosures and partitions shall be in accordance with [19] SANS 62271-203.

n) Earthing of the compact switchgear assembly gas-filled enclosures shall be in accordance with [19] SANS 62271-203.

i. Details of the compact switchgear assembly earthing between the enclosures, the steel support and the substation earth shall be provided on the general arrangement drawing as described in 3.2.20 0.

ii. The earthing philosophy shall prevent unacceptable transient voltages from appearing across sections of the metal enclosures and control circuits.

iii. No exposed copper or aluminium conductors shall be used for earthing of the Mixed Technology Unit, excluding the earth leads of the combined disconnector / earthing switch.

iv. The combined disconnector/ earthing switch's earth lead shall be a separate insulated copper connection from the earthing switch to a junction box, mounted at ground level on the switchgear's steel support. (One earth lead per phase.)

v. The insulation for the earthing leads and junction box shall be 1kV and the earthing leads shall have a short-time rating of 40kA for 3 seconds.

vi. The junction box will have removable links to facilitate primary injection and testing of the switchgear unit, on a per phase basis. The junction box must be insulated from the steel support. Testing terminals shall be provided for on the inside of the junction box such that tests can be performed through the earthling leads.

vii. The junction box shall have a door and meet the same mechanical, material and construction requirements as that of the mechanism box, including padlocking facilities.

viii. The opposite side of the removable links, on the substation earth side, shall be earthed through the steel support of the Mixed Technology Switchgear unit.

ix. The earthing of the Mixed Technology switchgear Unit, to achieve the above, shall be submitted with the tender and is subject to approval by Eskom.

o) Compact switchgear assembly shall be supplied with integrated ring-type Current Transformers (CTs).

i. For feeder compact switchgear, the CTs shall be located at the base of the combined disconnector / earthing switches.

ii. For Transformer compact switchgear, the CTs located on the busbar side of the unit shall be located at the base of the combined disconnector / earthing switch. The CTs located on the transformer side of the unit shall be located at the base of the outdoor bushings or cable connections.

iii. For further information on CT requirements, refer to 3.2.16.

3.2.3 Construction requirements

The design and layout of the compact switchgear assembly, 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 optimized such that on-site installation work is minimized. The following principles shall apply to the design of the equipment:

a) The various elements of the compact switchgear assembly shall be standardized. Standardization 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.

d) SF6 filter material housing shall be located (at the circuit-breaker pole) in such a manner as to provide easy access when maintaining the unit.

3.2.4 Compact switchgear assembly operating mechanism enclosure requirements

a) Compact switchgear assembly operating mechanisms (i.e. for the circuit-breaker and disconnector/earthing switches), 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 [10] SANS 60529. The degree of protection offered shall be stated in Schedule B.

i. Enclosures containing exposed bearings, auxiliary switches, motors and other electrical devices shall comply with IP 55 (i.e. operating mechanism enclosure).

ii. Where applicable, all open areas in the compact switchgear assembly frame as well as externally mounted indicating devices where there is a high probability of birds nesting, shall be suitably covered to IP 2X.

iii. All other enclosures provided shall comply with IP 54.

b) The operating mechanism enclosure shall be manufactured from 3CR12, stainless steel or aluminium with corrosion protection in accordance with 3.2.6, unless otherwise approved by Eskom.

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. All 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) Unless otherwise accepted by Eskom, the compact switchgear assembly shall be designed for operation from the front of the operating mechanism enclosure (position of local operation).

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, Miniature Circuit-breakers (MCBs) and secondary wiring terminal strips) in accordance with [16] SANS 62271-1.

f) Servicing shall be possible from the ground level.

g) The front access door(s) 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(s) 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 circuit-breaker 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 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 galvanized 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 set screw, washer and spring washer. The boss and the set screw on the enclosure shall be stainless steel of grades 304 and 316, respectively, unless otherwise approved by Eskom. The boss and the set screw on the circuit-breaker steel support structure (e.g. the common base frame or the steel column support) shall be galvanized steel.

NOTE: The use of copper or aluminium is considered to present a theft risk and will not be accepted.

m) The Marshalling Interface Box (MIB) (refer to 3.2.17 d.) shall make provision for the entry of Eskom control cabling from below. Refer to 3.2.17 c. for the requirements of the control cable entry gland plates. Where applicable, all compact switchgear assembly 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.

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

NOTE: The use of aluminium cable racking is considered to present a theft risk and will 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 operating mechanism enclosure(s).

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 enclosure(s) shall be 'light grey' (G29) in accordance with [6] SANS 1091 unless otherwise specified in Schedule A or approved by Eskom.

3.2.5 Compact switchgear assembly support structure and foundation

a) The following mechanical loads and parameters relating to the design of the compact switchgear assembly steel support structure and concrete foundation shall be stated in Schedule B and be shown on the general arrangement drawing (refer to 3.2.20 0:

iv. 'Static' dead weight of the compact switchgear assembly (N);

v. The rated 'static' terminal forces FshA, FshB and Fsv (loads) of the compact switchgear assembly (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 circuit-breaker itself) can be assumed to be in accordance with Table 14 of [17] SANS 62271-100. Refer to 6.101.6 of [17] SANS 62271-100.

vi. 'Dynamic' horizontal force (load) exerted during operation on the foundation (N);

vii. 'Dynamic' vertical force (load) exerted during operation on the foundation (N);

viii. 'Dynamic' moment (torque) exerted during operation about the foundation (Nm);

ix. 'Dynamic" horizontal force exerted between poles (centre phase interrupter chamber) during a rated (terminal fault) short-circuit (N);

x. Wind force (load) exerted on the compact switchgear assembly due to a wind velocity of 34 m/s (N);

xi. Maximum torque required for the foundation holding down bolt nuts used to secure the support structure column to foundation (N.m);

xii. Mounting and fastening arrangement for the compact switchgear assembly support structure onto the foundation including the minimum required length of foundation holding down bolts; and

xiii. Centre of gravity of the compact switchgear assembly.

b) The steel support structure shall be designed by the manufacturer.

c) If specified in Schedule A, the concrete foundation shall be designed by the manufacturer.

d) A drawing showing the steel support structure and concrete foundation design details shall be provided with the tender documentation (refer to 3.2.20 0 and the drawing number(s) shall be stated in Schedule B. The drawing shall include the relevant mechanical loads and parameters used in the design – as indicated in 3.2.5 a.

e) Provision shall be made for the on-site fitting of at least one Eskom 'type 2' electrical equipment label in accordance with [34] D-DT-5047 (sheets 2 and 4). This shall be achieved through the provision of a steel mounting bracket with the appropriate holes located 1,8 m above ground level on the steel support structure.

NOTE: Eskom will provide the electrical equipment label.

3.2.6 Corrosion protection and lubrication

a) All exposed metal that is not inherently corrosion resistant shall be protected against corrosion in accordance with [26] DSP 34-1658 for outdoor 'high' to 'very high', 'C4' and 'C5' (i.e. marine) corrosivity rating environments.

b) The minimum detailed standard ('DS') for all exposed metal in accordance with [26] 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 standard 'DS' number in accordance with [26] 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 3.2.20 0:

xiv. nuts, bolts, studs and washers;

xv. structural steel (common base frame, support structure legs, etc.); and

xvi. other exposed metal (excluding main terminals and gland plates).

d) The behaviour 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 3.2.20 0 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 gas-filled compact switchgear assembly, the supplier shall give details with the tender documentation (refer to 3.2.20 0) of the measures taken to prevent flange corrosion. These details shall include drawings of the flange arrangements, treatments 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:-

Table 4: 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
Material grade		(BS 970 080M40)
Type of corrosion protection		HD galvanising
Minimum thickness of protective coating		85 micro
Verification tests carried out on coating e.g. Thickness with thickness gauge		6 measurements along profile

Expected life of coating (Industry/marine)		Marine = 5 years; Industry = 8 years
Maintenance frequency of protection coating		Repair installation damage on commissioning and thereafter once a year
Maintenance type of protection coating		Patch repair with 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 coastal location in USA
Remarks/General comments		Debris, scratches and indentation have been removed prior to galvanising.

3.2.7 Compact switchgear assembly operating mechanism enclosure heaters

a) Suitably rated electric heater(s) shall be installed to prevent moisture condensation inside the compact switchgear assembly operating mechanism enclosure(s). The heater size offered shall be stated in Schedule B.

b) Heaters shall maintain a dew point greater than the ambient temperature and shall circulate the air constantly to all parts of the enclosure(s).

c) The electrical supply for heaters shall be AC 230 V, single-phase.

d) Heater control and alarm circuits shall comply with the requirements of [28] 240-56030489. In the case of 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 [35] D-DT-5409.

3.2.8 Interface requirements

3.2.8.1 Main (HV) terminals for outdoor bushings

a) Unless otherwise specified in Schedule A, the compact switchgear assembly main terminals shall be an eight-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 in accordance with [21] SANS 62271-301. The diameter of the holes shall be 14 mm (M12).

b) Fully dimensioned details of the main terminals shall be shown on the compact switchgear assembly general arrangement drawing (refer to 3.2.20 0.

3.2.8.2 Earthing terminals

NOTE: Earthing of the compact switchgear assembly to the main substation earth grid is achieved through the support structure and the insulated earth connections of the combined disconnector / earthing switch as described in paragraph 3.2.2.1 n).

i. The support structure shall be earthed through the foundation holding down bolts, unless otherwise specified or approved by Eskom.

ii. Provision shall be made for the on-site fixing of ball joint assemblies in the steel support structure. This shall be achieved through provision of 18 mm diameter holes in the steel support structure. Provision shall be made for six ball joints on single busbar compact switchgear assembly and nine ball joints on double busbar compact switchgear assembly. Ball joints shall be placed such that it is possible to connect 3 m long portable earth leads. Details of the positions of the ball joints shall be shown on the compact switchgear assembly general arrangement drawing (refer to 3.2.20 0 and shall be subject to Eskom approval.

NOTE: Refer to Eskom drawing [36] D-DT-6081 for the dimensions of the ball joints assemblies that will be supplied and applied by Eskom. Ball joints are used to connect Eskom's portable earth leads.

3.2.8.3 Cable connections

In the case of feeder/transformer compact switchgear assembly, if specified in Schedule A, provision shall be made for the dry type connection of power cables in accordance with [20] SANS 62271-209. Specific details regarding the cable requirements will be provided by Eskom at the time of tender. Provisions for the application of cable test voltages shall be in accordance with [19] SANS 62271-203.

a) The design of the cable end box shall fully comply with the latest IEC 62271-209 standard for dry-type terminations. The final connection of the high voltage or extra high voltage cable circuits in the compact switchgear assemblies' unit will be by means of individual single-phase cables, with one cable per phase. All cable end modules shall be suitable for connecting single core, XLPE solid dielectric cable for maximum continuous current.

b) The cable end unit design shall include a facility for high voltage and insulating testing of the connected power cable on site. The facility must be of a permanent nature and must preferably be designed in such a way that it prevents gas handling or removing of the cable terminations. The facility must be described in detail in schedule B.

c) The scope of supply shall be as defined in the IEC 62271-209 standard for dry-type terminations.

d) The fitting of the female compact switchgear assemblies' unit termination insulator and insulator collar or adaptor as specified in IEC62271-209 will be performed by the compact switchgear assembly unit OEM or the approved installer as and when required.

3.2.9 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 (OHS) Act No. 85 of 1993, shall be complied with. Electrical working clearances are given in 5 below.

Table 5: Minimum Electrical Working Clearances

System voltage (kV)	Working clearance (mm)
44 & 66	3 270
88 & 132	3 950

NOTE: The working clearance is calculated by summating the height of a person with his/her arm in an extended upward position (i.e. 1 800 mm + 700 mm = 2 500 mm) and the minimum safety clearance as required by the OHS Act No. 85 of 1993.

c) The distance from ground level to the base of any High-voltage (HV) (i.e. > 1 000 V) insulation shall not be less than 2 500 mm.

d) The requirements for internal faults (internal arc) and pressure relief devices shall be in accordance with [19] SANS 62271-203. The supplier shall provide details with the tender documentation (refer to 3.2.20 0 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 D.1 of [19] 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.

3.2.10 Insulation requirements for outdoor bushings

3.2.10.1 Bushings

a) Unless otherwise specified in Schedule A, the bushing material shall be of the silicone rubber composite type. The type of insulator material offered and manufacturer shall be stated in Schedule B.

b) Bushings of the silicone rubber composite type shall be in accordance with the requirements of [9] SANS 60137 (outdoor-immersed bushing), [13] SANS 60815-3 and [15] SANS 61462, as applicable.

c) The bushings of the compact switchgear assembly for use in systems of nominal voltage up to and including 132 kV shall be tested at Eskom's Koeberg Insulator Pollution Test Station (KIPTS) in accordance with [24] 240-56062328.

3.2.10.2 Minimum creepage distances

a) The minimum Unified Specific Creepage Distance (USCD) required in accordance with [11] SANS 60815-1 for external insulation shall be as specified in Schedule A. The USCD for external insulation has been rationalized to 53,7 mm/kV for all pollution conditions. A USCD of 53,7 mm/kV corresponds to a Specific Creepage Distance (SCD) of 31 mm/kV.

b) The actual creepage distance offered shall be stated in Schedule B.

3.2.10.3 Clearances in air

Phase-to-phase and phase-to-earth clearances, measured by the taut-string method, shall be stated in Schedule B.

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

3.2.11 Padlocking facilities

a) Facilities shall be provided to padlock the switchgear main circuit in the OFF, ON and EARTH positions.

b) Padlocking facilities shall be provided to prevent the selection of the ON position while permitting operation from OFF to EARTH or from the EARTH to OFF positions.

3.2.12 Motorized disconnector/earthing switches

a) All disconnector/earthing switches shall be motorized.

b) The auxiliary supply for the motorized operating device shall be DC 110 V or DC 220 V (refer to 3.1.8 a.) The continuous power rating of the motor together with the total operating time (i.e. time taken for the motor to operate the disconnector/earthing switch) shall be stated in Schedule B.

NOTE: The use of resistors to reduce the supply voltage to motors is not acceptable. The method used to achieve immunity to spurious operation due to induced surges in the control cables is subject to approval by Eskom.

c) Motorized disconnector/earthing switch motor control circuits shall comply with the requirements of [28] 240-56030489 and [35] D-DT-5409.

d) Local open/close control actuators shall be provided and labelled in accordance with 3.2.14 b.

e) Operation of more than one combined disconnector/earthing switch per motorized operating device will not be accepted.

f) Manual operation of the disconnector/earthing switches shall be possible in the event of an emergency. Provision shall be made for a pad-lockable selector switch, such that, in the 'manual' position, power supply to all the motor drives will be isolated. Such an arrangement shall ensure that closing of disconnectors or opening of earthing switches is not possible when they are mechanically locked in the open (OFF) or closed (EARTH) positions respectively.

3.2.13 Position/status indication

3.2.13.1 Position/status indicators

a) Each compact switchgear assembly shall include a mimic indicating the ON, OFF and EARTH positions of the main circuit(s).

b) The mimic shall be located so that it can be viewed without opening any door. The mimic indication shall be mechanical. The layout of the mimic shall be shown as part of the panel layout on the general arrangement drawings. The type of mimic shall be stated in Schedule B.

c) The following reliable and definite mechanical position/status indications shall be provided and coupled directly to the operating mechanism/drive shaft:

i. circuit-breaker contact status (open/closed);

ii. disconnector status (open/closed); and

iii. earthing switch status (open/earthed).

NOTE: The requirements for the kinematic chain required to provide reliable position indication for the disconnector/earthing switches are specified in [18] SANS 62271-102.

d) Where applicable, the following symbols and colours shall be used to indicate the position of a switching device:

i. closed position: 'I' in white lettering on a red background;

ii. open position: 'O' in white lettering on a green background;

iii. earthed position: '  ' (the earth symbol) in black on a yellow background.

e) Lettering size shall be at least 15 mm, unless otherwise approved by Eskom

f) The closing-spring condition (i.e. charged or discharged) shall be indicated by a mechanical device. It shall be clearly visible from outside the circuit-breaker 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, unless accompanied by an adjacent key label.

g) Each circuit-breaker shall be provided with an operation counter that is advanced each time the circuit-breaker 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 circuit-breaker 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.

h) 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.

i) The disconnector main contact status (i.e. open/closed) shall be visible through, for example, a viewing window / aperture / porthole. The method offered to achieve this requirement shall be stated in schedule B.

3.2.13.2 Main circuit live indication (feeder/transformer compact switchgear assembly)

a) An 'integrated' Voltage Detection System (VDS) with fixed voltage indicators and test points in accordance with [14] SANS 61243-5 shall be provided for main circuit live indication on feeder/transformer compact switchgear assembly. The VDSs location and the interlocking to the specific earthing switch shall be clearly visible from the position of local operation side.

b) The main circuit earthing interlocking system shall use a contact from the live indication system to prevent the earth being applied to a live ('back-energized') system. The design shall be such that no improper situations can occur in case of lack (failure) of auxiliary supply. Alternative interlocking systems providing the same functionality may be accepted. The interlocking system shall be subject to approval by Eskom.

3.2.13.3 Gas density indication (where applicable)

Where applicable, gas pressure gauges (compensated for temperature and responding to gas density) shall be provided for the compact switchgear assembly. These devices shall be sheltered from the elements to ensure that the reading provided is correct and to prevent ageing of the device.

3.2.14 Labels

a) Operating labels associated with local operation of the compact switchgear assembly shall be securely attached to the inside of the operating mechanism enclosure front access door(s) and be as follows (black text on white background, in English):

i. Instructions for mechanically tripping and closing the circuit-breaker: These instructions shall be titled 'TO TRIP CIRCUIT-BREAKER' and 'TO CLOSE CIRCUIT-BREAKER', respectively. Additional information required to perform these functions shall be referred to Eskom.

ii. Instructions for charging the closing spring: The instruction shall be titled 'TO CHARGE SPRING' and located near the actuator for local mechanical spring charging.

iii. Instructions for isolating and earthing the main circuit: These instructions shall be titled 'TO ISOLATE AND EARTH MAIN CIRCUIT'. Additional information required to perform these functions shall be referred to Eskom.

b) The actuator(s) for local opening and closing of switching devices shall be identifiable by all three of the following methods:

i. By labelling, in English, printed with black text on a white background reading 'TRIP/OPEN' and 'CLOSE', respectively. The symbols 'O' and 'I' may be used as additional means to identify the respective trip and close controls.

ii. By actuating direction or position. A rotary switch shall be turned anticlockwise to trip/open the switching device and clockwise to close the switching device. Trip/open and close push buttons shall be oriented vertically or horizontally and shall have the trip/open button at the bottom or to the left of the close button [3] IEC 60447].

iii. By colour-coding. The colour green shall be associated with the trip/open control and red with the close control. Alternatively, the controls shall be without unique colour.

NOTE:

1) The Eskom colour-coding convention for open/close actuators is opposite to that specified in [1] IEC 60073 (i.e. IEC requires trip red and close green).

2) 'TRIP' is only used to refer to the opening of switching devices (i.e. circuit-breakers) incorporating stored energy operating mechanisms, otherwise the term 'OPEN' is used.

c) An appropriate warning label shall be displayed to draw attention to the danger of performing manual operations without an adequate amount of gas inside the gas compartments of the circuit-breaker.

d) A warning label shall be displayed within the operating mechanism enclosure to draw attention to the minimum time interval required between repeated close and open 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 [25] 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. The method used to attach labels shall be stated in Schedule B.

3.2.15 Requirements for gas-filled compartments (where applicable)

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

a) All compact switchgear assemblies shall be factory-filled with new gas at the rated transportation pressure (refer to 3.2.21 n.). When installation is called for, compact switchgear assembly shall be filled with new gas at the rated normal pressure.

b) The requirements for gas tightness shall be in accordance with [19] SANS 62271-203. The maximum gas leakage rate per year from any single gas-filled compartments shall be stated in Schedule B. The quantity of gas required for each separately filled compartment shall be stated in Schedule B.

c) SF6 gas supplied in cylinders for filling the compact switchgear assembly shall comply with the requirements of [2] IEC 60376. A certificate guaranteeing SF6 purity shall be supplied with all cylinders.

d) In the case of SF6 switchgear, the following parameters shall be checked, recorded and a report submitted to Eskom after filling:

   i. SF6 content (purity) – not less than 98%.

   ii. 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 [5] NRS 087 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 gas-filled compartment filling and pressure monitoring:

   i. Gas filling/evacuation points with DILO DN8 connections shall be provided.

   ii. 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.

   iii. 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.

   iv. A dial-type gauge responding to gas density and indicating gas pressure compensated for temperature shall be provided and suitably sized (typical 80 mm to 100 mm diameter).

   v. A 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 [28] 240-56030489.

   vi. Electrical interlocks and alarms provided by the gas density monitoring device shall be in accordance with [28] 240-56030489.

   vii. Pressure gauges shall be numerically marked and calibrated in pascal (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.

   viii. The density monitoring device shall be suitable for outdoor application and resistant to operating vibrations, outdoor elements (hail/snow), etc.

ix. The type of gauge utilized shall be designed such as to prevent any corrosion of moving parts and contacts inside the gauge.

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

xi. Gas 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.

xii. Non-return valves shall be fitted on all DN8 fittings and pipework such that the gas pressure is maintained in the system and pipework when a component/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 e) a.)

xiii. Any pipework shall be made of stainless steel and mounted in such a manner that it is mechanically protected. The use of tinned copper pipes is acceptable if this is done in the factory before mounting to the circuit-breaker common base frame.

xiv. A single common gas filling/evacuating and gas density monitoring point for all poles may be provided.

xv. 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.

xvi. Cabling to the gas density monitoring device shall be secured, protected from the elements and run into enclosures through a suitable compression gland or rubber grommet.

xvii. Complete details of all gas pressure devices, including drawings; manufacturer's standards; performance and test data; details of production tests; and a quality control programme, shall be included with the tender documentation (refer to e) a.)

f) Where applicable, the management of SF6 gas shall be in accordance with [5] NRS 087.

3.2.16 Current transformers

a) Current Transformers (CTs) shall be of the dry-type and manufactured and tested in accordance with [7] SANS 60044-1. The make and type of CT offered shall be stated in Schedule B.

b) The number and type of CT cores required per phase, together with their position relative to the circuit-breaker and their respective standards (tappings, ratios, classes, burdens, knee-point voltage, excitation currents at knee-point voltages and secondary resistances, where applicable) will be specified in Schedule A and shall be in accordance with [28] 240-56030489 and [35] D-DT-5409.

c) Note: Measurement cores should not be positioned underneath the heavy protection cores, as this can distort their cores and affect the accuracy.

d) The CT terminal numbering and wiring interface shall be in accordance with [35] D-DT-5409.

The CT terminal block connectors shall conform to the terminal block [43] specification 240-70413291. Under no circumstances shall any form of slide-on terminal connection be accepted. All connections shall be done via a ring lug with appropriate washer and lock washer and fastening nut or the spring loaded hook blade terminal block capable of accepting a $4mm^2$ yellow hook blade lug.

e) The CTs shall be properly fixed and mechanically supported so that no movement is allowed during transportation or service fault conditions. Details of the CT fixing arrangement and mechanical support shall be included with the tender documentations (refer to e) a.)

f) The CT polarity shall be clearly indicated on the circuit breaker in terms of P1 and P2 and shall conform to D-DT-5409

g) The complete CT specification (technical data sheet) nameplate shall be fixed onto the compact switchgear assembly on the CT terminal box or in close proximity to the CT terminal box. In addition the control plant wiring mechanism box containing the CT wiring from the CT terminal box shall have the same label affixed on the inside of the mechanism box door. A copy of this label shall be indicated on the schematic diagram as per section 3.2.17.

3.2.17 Auxiliary and control circuits

3.2.17.1 General requirements of the auxiliary and control circuits

a) The auxiliary and control circuits shall be designed and implemented in accordance with the requirements of [28] 240-56030489 and [35] D-DT-5409.

b) The type and relative timing of disconnector auxiliary switch contacts shall be in accordance with [35] D-DT-5409.

c) Unless otherwise approved by Eskom, removable 3 mm thick brass or aluminium gland plates (undrilled and unpainted), each having a minimum usable area of 200 mm x 100 mm, shall be fitted below each terminal strip for the bottom entry and glanding of all control cables. Each gland plate shall be secured by a minimum of six M8 set screws with nuts and washers, unless otherwise approved by Eskom. Earthing of the gland plates shall be via the set screws.

d) Provision shall be made for the entry of all Eskom Low-voltage (LV) control cables to one MIB. 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) It shall be possible to change the DC control voltage at which the compact switchgear assembly operating mechanism operates by only replacing the opening and closing coils, operating mechanism motors and motor contactor coils.

NOTE:

1) Switchgear shall only be required to operate at one DC 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 DC 110 V or DC 220 V as specified in Schedule A.

2) A readily available DC supply voltage ‘conversion kit’ may be required by Eskom from the supplier in order to convert the compact switchgear assembly operating mechanisms from DC 110 V to DC 220 V or vice versa. Refer to 3.5.3.5.

g) An interlock shall be provided to prevent the compact switchgear assembly unit from being re-energised until the removable earth leads of paragraph 3.2.2.1. n) vi. have been reinstalled correctly to earth the unit.

h) The supplier shall provide the manufacturers’ compact switchgear assembly control schematic which is complying with the Eskom D-DT5409 schematic, This is necessary for Eskom to ensure that the schematics are compliant with D-DT5409. The submitted schematic shall fully cover the configuration of the specified compact switchgear assembly inclusive of circuit breaker, disconnector and earth switch control.

NOTE: The CT label requirement under clause 3.2.16.

i) All terminations shall use terminal blocks in accordance with the [43] specification 240-70413291.

j) All wiring shall be identified using numbers, at each end, following the alphanumeric wire identification conventions stated in the generic equipment standard for wiring, wire marking and cable numbering, in accordance with the [44] standard 240-64636794.

k)

3.2.17.2 Requirements for the digital secondary plant interface option

NOTE: The Supplier shall conform with the secondary wiring in the standard analogue secondary plant interface. Upon the specific request indicated on the Technical schedule issued by Eskom, the tender submission shall submit also the option of the digital secondary interface, over and above the analogue secondary plant interface standard requirement.

An option shall be provided for a digital interface to the auxiliary and control circuits based on IEC 61850 [37] 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 [37]. 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 [40] 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 [37] communication and remote engineering access.

The Supplier shall complete the Schedules A&B of Eskom Standard 240-6465228 [40] 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 [39]. 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)

c) SCBR – Supervision and monitoring: circuit-breaker 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 [41] 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.

3.2.17.3 Additional requirements for the point-on-wave controller

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 3.2.8.4.

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

3.2.18 Nameplates

a) The compact switchgear assembly nameplate shall contain the necessary information specified in [22] SANS 62271-205 and the following:

   i. Eskom order and contract number.

   ii. Eskom stock (SAP) number.

   iii. Rated single-phase short-circuit breaking current - where applicable 3.1.5 b).

b) The circuit-breaker operating device nameplate shall contain the necessary information specified in [17] SANS 62271-100 and the following:

   i. Trip-coil rated voltage, current, DC resistance (at 20 °C)

   ii. Close-coil rated voltage, current, DC resistance (at 20 °C).

   iii. 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) Duplicate nameplates of the CTs shall be attached to the inside of the MIB front access door in order for them to be read from ground level. The nameplate shall also depict the position of the CTs relative to the switching devices.

d) The actual ratings to which the compact switchgear assembly has been type-tested (and not merely the values specified) shall be displayed.

e) The nameplates and their fixings shall be weatherproof 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 and the method shall be stated in Schedule B. The use of glue to fasten the nameplates will not be accepted. The nameplate material offered shall be stated in Schedule B.

3.2.19 Tools and spares

a) A full set of operating tools necessary to carry out all mechanical (manual) operations of the compact switchgear assembly shall be supplied with each unit (racking handle, spring charging handle, etc.). A full list of operating tools shall be provided with the tender documentation (refer to e) a.) 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, unless otherwise approved by Eskom.

c) A detailed list of standard tools required for minor maintenance shall be supplied with the tender documentation (refer to e) a.) Where applicable, the following tools are required for minor maintenance:

   i. slow operating device(s);

   ii. hoses and fittings for draining and filling with gas; and

   iii. other tools which may be required (e.g. contact alignment tools, gas density meter checking device).

d) Should the compact switchgear assembly require additional specialized tools for major maintenance purposes, a full list of specialized maintenance tools shall be provided with the tender documentation (refer to e) a.).

e) A full list of spares required for maintenance shall be provided with the tender documentation (refer to e) a.).

3.2.20 Documentation requirements

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

a) A completed Technical Schedule B for each compact switchgear assembly offered. 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 showing the following minimum information:

   i. manufacturer’s drawing number and revision number;

   ii. a descriptive title of the drawing (e.g. ‘132 kV 2 500 A Feeder/Transformer Compact Switchgear Assembly General Arrangement’);

   iii. critical dimensions such as overall dimensions, structure dimensions, phase to phase spacing,

   iv. phase to phase and phase to earth air clearances, working clearance, height of lowest part of HV insulation above ground, height of top of operating mechanism enclosure above ground, operating mechanism enclosure dimensions, overall height, width and depth of circuit-breaker, etc.;

   v. properly annotated drawing with a complete list of major components (bill of materials);

vi. details of main terminals including dimensions of the fixing holes, terminal hole spacing, plate

vii. thickness and maximum permissible forces (loads) on main terminals (with directions) expressed in Newton (N);

viii. mass of compact switchgear assembly in kilograms (kg), which shall include the total mass of compact switchgear assembly ready for service and the mass of filling medium;

ix. the steel support structure dimensioned outline and general arrangement;

x. the steel support structure label mounting holes;

xi. the concrete foundation dimensioned outline, design detail and general arrangement;

xii. mounting and fastening arrangement for the compact switchgear assembly 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;

xiii. maximum torque required for the foundation holding down bolt nuts used to secure the support structure base plate expressed in Newton metre (N.m);

xiv. static and dynamic forces (loads), with directions, and centre of gravity – refer to 3.2.5 a.);

xv. relative location of compact switchgear assembly poles, steel support structure and operating mechanism enclosure(s);

xvi. location of all enclosure doors and handles;

xvii. details of the positions (18 mm diameter holes) provided for the mounting of ball joints for portable earthing – refer to 3.2.8.2;

xviii. location and annotation of control facilities (gas filling/evacuation points, gas density monitoring device with, where applicable, its environmental protection shelter/cover, etc.);

xix. location and layout of LV control cable gland plates;

xx. where applicable, gas pressure and quantity requirements; and

xxi. location of nameplate on compact switchgear assembly.

c) For all bushings, detailed drawings showing the shed profile dimensions including shed and insulation body/core diameters, shed spacing, creepage distance and dry arcing distances, etc.

d) Details of the CT fixing arrangement and mechanical support (refer to 3.2.16 d.)

e) Drawings showing the generic layout of all the nameplates (circuit-breaker, disconnector/earthing switch, operating device(s), CTs) in accordance with 3.2.18.

f) The auxiliary and control circuit schematic wiring diagrams for the compact switchgear assembly in accordance with 3.2.17.

g) A GA drawing of the MIB and operating mechanism enclosure(s).

h) Full list of spares required for maintenance (refer to 3.2.19 e. and 3.5.1).

i) Full list of operating tools (refer to 3.2.19 a.)

j) Detailed list of standard tools required for minor maintenance (refer to 3.2.19 c.)

k) Detailed list of additional specialized tools for major (specialized) maintenance (refer to 3.2.19 d.)

l) Full list of the type tests as well as copies of type test reports and/or certificates for the compact switchgear assembly – including the CTs and bushings (refer to 3.3.1.3 and 3.3.2).

m) Generic routine test certificates for the compact switchgear assembly – including the circuit-breaker, disconnectors, earthing switches, CTs and bushings (refer to 3.3.1.3 and 3.3.2).

n) Transport, storage, installation, operating and maintenance manuals (refer to 3.6 Manuals).

o) Training material (refer to 3.7 Training)

p) The submission, where applicable, of the following additional information:

q) Premature failures experienced in service of compact switchgear assemblies of similar design supplied elsewhere by the manufacturer, together with the recommended modifications (refer to 3.2.2 h.);

r) details of corrosion protection and lubricants offered (refer to 3.2.6 d.);

i. measures taken to prevent flange corrosion (refer to 3.2.6 e.);

ii. details of the internal arc behavior of the circuit-breaker (refer to 3.2.9 d.);

iii. details of the arrangements offered to maintain gas pressure in the system when a component/pole or the density monitoring device is removed or replaced (refer to e) k.);

iv. details of all gas pressure devices, including drawings, manufacturer's standards, performance and test data, details of production tests and a quality control programme (e) p.);

v. quality control plans indicating all inspection hold points (refer to b) c.);

vi. details of equipment requiring maintenance during storage (refer to 3.4.5 a.);

vii. a written commitment from the supplier regarding the submission of the maintenance Digital Versatile Disc (DVD) (refer to 3.5.2); and

viii. spares availability philosophy (refer to 3.5.3.2).

s) Unless otherwise specified in Schedule A, the manufacturer shall submit the following documentation with each compact switchgear assembly delivered to Eskom:

i. an auxiliary and control circuit schematic wiring diagram of the compact switchgear assembly;

ii. a complete set of routine test certificates;

iii. a commissioning and hand-over test sheet; and

iv. one set of transport, storage, installation, operating and maintenance manuals.

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

t) The above documents supplied with the compact switchgear assembly shall be stored in the documentation pocket on the inside of the compact switchgear assembly operating mechanism enclosure front access door.

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

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

i. circuit-breaker analyser data required for condition monitoring (refer to 3.5.5);

ii. detailed scope of works (job plan) for each type of prescribed maintenance intervention;

iii. detailed work instructions (task manual) for each type of prescribed maintenance intervention; and

iv. detailed works reports (check sheet) for each type of prescribed maintenance intervention.

v) All documentation shall be evaluated and accepted by Eskom prior to manufacturing.

3.2.21 Packaging requirements

a) Each compact switchgear assembly shall be 'unit-packed'. In other words, the components making up a complete compact switchgear assembly shall be delivered to site in one or more packing containers which shall contain only the components for one complete individual circuit-breaker.

NOTE: Eskom will not accept equipment if the various components of the different compact switchgear assemblies are delivered in the same packing containers.

b) All compact switchgear assembly 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) in the open (i.e. exposed to the elements).

c) Durable waterproof packaging shall prevent damage to the compact switchgear assembly components during transportation and storage on site and shall be such that suitable ventilation is allowed in order to minimize condensation.

d) The packaging shall be able to withstand impact loadings of at least 18 kN. The mechanical strength of the packaging shall not be dependent on the strength of the top cover, i.e. it shall be possible to remove and subsequently replace the top cover without losing any mechanical strength of the packaging.

e) Where more than one crate is used per compact switchgear assembly, each crate shall be clearly and sequentially marked in order to identify each crate as belonging to a specific circuit-breaker (e.g. 'CRATE 1 of 3', 'CRATE 2 of 3').

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:

i. Eskom order number;

ii. Eskom SAP number;

iii. a short compact switchgear assembly description (including the rated voltage, normal current, rated short-circuit breaking current, auxiliary DC control voltage and specific creepage);

iv. manufacturer's name (i.e. make of compact switchgear assembly);

v. manufacturer's compact switchgear assembly product designation/code (i.e. type of compact switchgear assembly);

vi. manufacturer's serial number(s);

vii. contents of the crate (i.e. a parts list);

viii. crate number (e.g. 'CRATE 1 of 2', 'CRATE 2 of 2');

ix. crate overall dimensions (in millimetres);

x. total mass of each crate (e.g. 'TOTAL MASS: 1 000 kg'); and

xi. 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) Forklift 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 AC supply 230 V connection point for the heater circuit during storage shall be provided and wired to the Eskom side of the terminal strip in the factory. This shall consist of an electrical cord wired to a screw-type connection block for the connection of the temporary AC supply used during storage. Heater connections shall be designed in such a manner so as not to cause a hazardous situation when energized. No internal wiring should need be modified to remove the temporary supply leads. The connection point shall be labelled 'AC 230 V 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 circuit-breaker body and not the packaging.

m) Where applicable, the compact switchgear assembly shall be transported with a positive gas pressure of maximum 150 kPa (refer to 3.2.15 a.)

n) A copy of the Bill of Materials (BOM) shall be provided with the delivery note for each circuit-breaker 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

3.3.1.1 Manufacturer's testing capabilities

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

3.3.1.2 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 compact switchgear assembly 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 eight 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.

3.3.1.3 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 e) a.). The type test reports and/or certificates and the summary of type tests shall be in both printed copy and in electronic Portable Document Format (PDF). The type test reports shall be in electronic Portable Document Format (PDF).

i. The type test certificate which is the proof of official accreditation shall have the official signatures of the accredited test laboratory where the type-tests were performed which is responsible for its validity and contents. The type test certificate shall contain a record of series of type-tests carried out strictly in accordance with the IEC standard. It shall contain essential drawings and the equipment tested.

ii. Where the Supplier and OEM are using the type test certificate and type test report beyond that particular equipment that was type tested, to indicate that the other equipment types with their different ratings are covered by the type test certificate and type test report, a separate official signed off letter on the company's letterhead shall be supplied by the Supplier with the tender documentation. This letter shall clearly state all particular tests and the tested parameters that are extrapolated form the type test certificate and type test report.

iii. 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 e) a.) 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 authorized Eskom representative.

c) The electronic format (Adobe PDF) and one hard copy of the routine test certificates/reports shall be supplied with each circuit-breaker and stored in the documentation pocket inside the operating mechanism enclosure. In addition to the hard copy, 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 compact switchgear assembly design offered. The type test certificates and reports shall be submitted for review during the tender or product evaluation stage. Unless otherwise accepted by Eskom, type test reports shall not be older than 10 years. All the testing shall be carried out with the compact switchgear assembly in its entirety, in accordance with [22] SANS 62271-205. 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 compact switchgear assembly shall be type tested in accordance with [22] SANS 62271-205 and shall include the following tests:

i. Compact switchgear assembly dielectric tests ([22] SANS 62271-205 6.2 and [19] SANS 62271-203 6.2);

NOTE: Dielectric tests performed as type tests are required to be followed by a partial discharge measurement in accordance with [19] SANS 62271-203.

ii. Compact switchgear assembly temperature rise and measurement of resistance of circuits ([22] SANS 62271-205 6.5 and 6.4 and [19] SANS 62271-203 6.5 and 6.4);

iii. Compact switchgear assembly current withstand – main circuit ([22] SANS 62271-205 6.6 and [19] SANS 62271-203 6.6).

iv. Circuit-breaker short-circuit making and breaking capacities ([19] SANS 62271-203 6.101 and [17] SANS 62271-100 6.102 to 6.106).

v. Circuit-breaker critical current tests (where applicable) ([17] SANS 62271-100 6.107).

vi. Circuit-breaker single-phase tests (for Un >_ 66 kV) ([17] SANS 62271-100 6.108).

vii. Circuit-breaker double earth fault tests (for Un ≤ 132 kV) ([17] SANS 62271-100 6.108).

viii. Circuit-breaker short-line fault tests (for class S2 circuit-breakers and Un >_ 66 kV) ([17] SANS 62271-100 6.109).

ix. Circuit-breaker out-of-phase making and breaking tests (applicable if an out-of-phase rating is assigned) ([17] SANS 62271-100 6.110)

x. Circuit-breaker capacitive current switching tests ([17] SANS 62271-100 6.111).

xi. Compact switchgear assembly radio interference voltage tests (for Un >_ 132 kV) ([22] SANS 62271-205 6.3).

NOTE: The test applies only to bushings in accordance with [19] SANS 62271-203.

xii. Compact switchgear assembly verification of the protection (International Protection (IP) coding and mechanical impact test) ([19] SANS 62271-203 6.7)

xiii. Compact switchgear assembly gas tightness test ([19] SANS 62271-203 6.8)

xiv. Compact switchgear assembly Electromagnetic Compatibility (EMC) tests (for (Jn ≥ 132 kV) ([19] SANS 62271-203 6.9), where applicable.

xv. X-radiation test procedures for vacuum interrupters ([17] SANS 62271-100), where applicable.

xvi. Compact switchgear assembly mechanical and environmental tests ([22] SANS 62271-205 6.101).

NOTE: The requirements of [19] SANS 62271-203 6.102 are included in [22] SANS 62271-205 6.101.

xvii. Circuit-breaker mechanical operation ([17] SANS 62271-100 6.101.2.1 to 6.101.2.3).

xviii. Circuit-breaker extended mechanical endurance tests (for class M2 circuit-breakers) ([17] SANS 62271-100 6.101.2.4).

xix. Disconnector/earthing switch operating and mechanical endurance tests ([18] SANS 62271-102 6.102).

xx. Disconnector/earthing switch tests to verify the proper functioning of the position indicating device ([18] SANS 62271-102 6.105).

xxi. Disconnector bus-transfer switching tests ([18] SANS 62271-102 6.106) – applicable to double busbar compact switchgear assemblies only.

xxii. Proof tests for enclosures ([19] SANS 62271-203 6.103).

xxiii. Pressure test on partitions ([19] SANS 62271-203 6.104), where applicable.

xxiv. Compact switchgear assembly tests under conditions of arcing due to an internal fault ([19] SANS 62271-203 6.105).

xxv. Insulator tests ([19] SANS 62271-203 6.106).

xxvi. Corrosion test on earthing connections ([19] SANS 62271-203 6.107).

xxvii. Compact switchgear assembly additional tests on auxiliary and control circuits ([16] SANS 62271-1 6.10).

c) Time-current curves of the circuit-breaker 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 compact switchgear assembly shall be routine tested in accordance with [22] SANS 62271-205 and shall include the following tests:

i. Compact switchgear assembly dielectric test on the main circuit ([22] SANS 62271-205 7.1 and [19] SANS 62271-203 7.1).

NOTE 1: The dielectric test shall be repeated with each individual mechanical switching device (or isolating distance) in the open position in accordance with ([16] SANS 62271-1, ([22] SANS 62271-205 and [19] SANS 62271-203, clause 7.101).

NOTE 2: The measurement of partial discharges shall be performed as a routine test in accordance with [19] SANS 62271-203.

ii. Compact switchgear assembly tests on auxiliary and control circuits ([22] SANS 62271-205 7.2).

NOTE: In the case of switchgear supplied from an overseas Original Equipment Manufacturer (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 3.4.1).

iii. Compact switchgear assembly measurement of the resistance of the main circuit ([22] SANS 62271-205 7.3).

iv. Compact switchgear assembly functional tests on auxiliary and control circuits ([22] SANS 62271-205 7.101).

v. Compact switchgear assembly tightness test ([22] SANS 62271-205 7.4).

vi. Compact switchgear assembly design and visual checks ([19] SANS 62271-203 7.5).

vii. Compact switchgear assembly pressure tests of enclosures ([19] SANS 62271-203 7.101).

viii. Compact switchgear assembly mechanical operations tests ([19] SANS 62271-203 7.102).

ix. Circuit-breaker mechanical operating tests ([17] SANS 62271-100 7.101).

x. Disconnector/earthing switch mechanical operating tests ([18] SANS 62271-102 7.101).

xi. Compact switchgear assembly tests on auxiliary circuits, equipment and interlocks in the control mechanism ([19] SANS 62271-203 6.103).

xii. Compact switchgear assembly pressure test on partitions ([19] SANS 62271-203 6.104).

e) The following circuit-breaker characteristics, in addition to those specified in [17] SANS 62271-100, shall be measured and recorded during the mechanical operating tests (where applicable):

i. Closing and opening speeds.

ii. 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 circuit-breakers when operated simultaneously).

iii. Settings of pressure switches/gas density monitoring devices.

iv. Time-current curves of the electrical tripping and closing circuits for normal operation. The resolution of the function times shall clearly be indicated in the test reports.

f) The compact switchgear assembly for use in systems of nominal voltage up to and including 132 kV shall be tested at Eskom's Koeberg Insulator Pollution Test Station (KIPTS) in accordance with [24] 240-56062328. The products which have KIPTS certification will be technically preferred Suppliers if all other tender returnables are successful, see Technical Bulletin 06TB-027

g) CTs shall be tested in accordance with [7] SANS 60044-1 or [4] NRS 029, as applicable.

h) Bushings (of the silicone rubber composite type) shall be tested in accordance with [9] SANS 60137 and [13] 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 [19] SANS 62271-203 10.2.101 (where applicable) and [17] SANS 62271-100 10.2.101 and 10.2.102 for all compact switchgear assemblies. The test programme shall be incorporated into the compact switchgear assembly 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:

i. measurement of the steady-state contact resistance of the main circuit; and

ii. measurement of the dynamic contact resistance of the main circuit.

c) The measurement of the circuit-breaker 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 ± 5% of the times, as specified on the circuit-breaker pass sheet supplied by the OEM.

d) For each measurement of the circuit-breaker 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 circuit-breaker recharging 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 ± 2% of the circuit-breaker pass sheet results supplied by the OEM.

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

i. total travel (in millimetres);

ii. over-travel (in millimetres);

iii. rebound (in millimetres);

iv. under-travel (in millimetres);

v. contact penetration (in millimetres);

vi. moving-contact or operating rod position at the time of make or break;

vii. anomalies which are evident from the trace;

viii. average speed on closing (in metres per second);

ix. average speed on opening (in metres per second).

g) For the measurement of the steady-state contact resistance of the main circuit, a DC current of at least 100 A shall be used. The dynamic contact resistance shall be measured during a close and open operation of the circuit-breaker. 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 micro ohm and the resolution shall be at least 1 μΩ.

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 circuit-breaker pass sheet) shall be clearly stated and corrections shall be made.

i) 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 handover as part of the quality process. All tests may be witnessed by Eskom. Refer to 3.4.7 b. 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 control-gear, 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 3.2.20 n).

3.4.2 Inspection of manufacturing facilities and circuit-breakers

a) Eskom reserves the right to inspect and evaluate all manufacturing and testing facilities relating to the compact switchgear assembly offered, both before and at any time during manufacturing.

b) Eskom reserves the right to inspect any ordered compact switchgear assembly 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 3.2.20 0 the supplier shall submit the quality control plans to Eskom, indicating all inspection hold points. Eskom may add the necessary inspection hold and/or witness points for Eskom or its appointed representative. The supplier shall make due allowance for these activities in the manufacturing programme and, to avoid delays, shall give sufficient, agreed-upon, advanced notice of the date of inspection. Eskom will not accept late delivery on the basis of inspection delays. The generic inspection and test plans (ITPs) for manufacturing, testing, transport, storage, installation and pre-commissioning shall be accepted by Eskom prior to manufacturing the first unit.

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

d) Any deviations in the compact switchgear assembly design shall be pointed out in accordance with the tendered deviation schedule and the type test certificates provided for the specific unit design. No clearance will be given where there is no satisfactory evidence of the relevant type test certificates, where such tests are required. All deviations shall be accepted by Eskom in writing.

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

3.4.3 Conditions during transportation, storage and installation

a) Conditions can be expected to be onerous during transport, storage and installation. Adequate precautionary measures shall be provided for the 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 considered. Refer to 3.2.21 m. 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:

i. Shipping test

This test shall cover all the conditions to be encountered during transportation from factory to the designated site, including loading/offloading from one mode of transport to another.

ii. Vibration test

This test may be used to supplement actual shipping tests to check for unexpected shortcomings in the equipment and packaging.

iii. Weatherproof 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 tests described in 3.4.3 c. may be waived at Eskom's discretion.

3.4.4 Transportation, offloading and storage

a) Refer to e) s. for the requirements for packaging for transportation and storage.

b) The supplier shall be responsible for the transportation and offloading of the equipment on site. Offloading includes transportation from the point of offloading the equipment after transportation to the point of installation.

c) The supplier shall provide its own means of offloading at the point of installation.

3.4.5 Storage

a) If any equipment requires maintenance or attention during storage, this shall be clearly stated in the contract and Eskom's attention shall be drawn to this fact. This information shall be submitted with the tender documentation (refer to 3.2.20 n) as well as with orders upon awarding of a contract.

b) At the time of offloading at an Eskom facility, the supplier has the responsibility to ensure that the necessary steps are taken by Eskom to ensure satisfactory storage.

c) Where heaters need to be energized, a clearly marked electrical connection point (refer to 3.2.21 l.) shall be provided to enable Eskom to supply power to the heaters.

d) The supplier shall implement proper storage and handling (de-stuffing) procedures. A copy of the storage and handling procedures shall be made available to Eskom for acceptance (refer to 3.2.20 n). This shall indicate the maximum recommended period of storage, as well as recommended actions to be taken if a longer storage period is required.

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.

b) Installation includes mounting and securing the equipment and its support structure onto the concrete support foundation, levelling of the switchgear, grouting where necessary, and filling of gas, where applicable.

c) For each type of compact switchgear assembly, the installation instructions provided by the supplier (refer to 3.2.20 n) according to the OEM's instructions shall at least include the following items:

i. 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.

ii. 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.

iii. Mounting

Instructions for mounting the poles, operating device(s) and auxiliary equipment shall include sufficient details to enable site preparation to be completed. These instructions shall also indicate:

1) total mass of the equipment, inclusive of extinguishing or insulating gases;

2) mass of extinguishing or insulating gases; and

3) mass of the heaviest part of the apparatus to be lifted separately if it exceeds 100 kg.

d) Qualification of personnel

All personnel employed by the supplier, who are involved in the installation and pre-commissioning of the compact switchgear assembly, 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.

e) Final installation inspection and testing

Instructions shall be provided for inspection and testing after the switchgear and controlgear have been installed and all the interfacing connections have been completed. These instructions shall include the following:

i. procedures for carrying out any adjustment that may be necessary to achieve correct operation;

ii. recommendations for any relevant measurements that should be made and recorded to help with future maintenance decisions; and

iii. instructions for final inspection and testing.

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

g) 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.

h) Installation tools/equipment and debris shall be removed from site when installation is completed.

i) Where AC power supplies cannot be made available to the supplier for installation and pre-commissioning purposes, the supplier shall be responsible for providing its own AC power supply (e.g. generator) for the installation and pre-commissioning of switchgear.

3.4.7 Pre-commissioning

a) Each compact switchgear assembly shall be tested after installation in accordance with 3.3.3 to assure proper installation and that no damage occurred during transportation. The pre-commissioning tests shall be witnessed by an appointed Eskom representative/official. To facilitate the testing, adequate DC power supplies, test equipment and suitably qualified and accredited personnel shall be provided by the supplier.

NOTE:

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

2) Elcon – SA10 Instrument, Sweden.

3) Programma Elektrik AB – TM 1600 or TM 1800 Instrument, Sweden.

4) The software used shall be compatible with any one of the above instruments, and will be specified when ordering the circuit-breaker. The choice may depend on the where the circuit-breaker will be used.

b) A compact switchgear assembly pre-commissioning test report shall be submitted to Eskom, comprising the following parts:

i. After the measurements at the substation site, a handwritten pre-commissioning test report shall be handed over to the appointed Eskom representative/official.

ii. Within three weeks after the pre-commissioning tests, the supplier shall submit an official report to Eskom (two hard copies).

iii. An electronic copy of the official report shall be provided on a Compact Disc (CD) for each individual circuit-breaker. 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.

c) All the measured values, and compliance with specified values and tolerances, shall be clearly stated in the report as well as the following:

i. Test/measuring equipment information/data

ii. make and type of instruments;

iii. serial numbers of instruments;

iv. methods of triggering;

v. measuring methods;

vi. accuracy of the instruments; and

vii. calibration certificates of the measuring instruments used.

viii. Compact switchgear assembly data

ix. make and type;

x. serial numbers of poles and operating mechanisms;

xi. rated voltage, normal current and short-circuit breaking current;

xii. name of the substation and section;

xiii. compact switchgear assembly identification and application;

xiv. date of commissioning; and

xv. date and time of testing/measuring.

d) Clear copies of the complete printouts of the circuit-breaker 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 compact switchgear assembly is found to be faulty during the tests, a fault report shall be completed in addition to the pre-commissioning test report.

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

f) After the final inspection, the final commissioning of the plant is performed and the handover 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 MSDSs.

3.4.9 Requirements for pressure vessels (where applicable)

Compact switchgear assemblies, which are subject to the provisions of the OHS 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, as required, to the appointed inspection authority calculation sheets, design drawings, welding procedures and welding X-rays 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 [51] Appendix D, field service bulletins and DVD material covering the following aspects:

3.5.1.1 Extent and frequency of maintenance

i. For this purpose, the following factors shall be considered:
ii. switching operations (e.g. circuit-breaker accumulated switching amperage);
iii. 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 circuit-breaker once the accumulated switching amperage limit has been reached);
iv. environmental conditions;
v. measurement and diagnostic tests for condition monitoring; and
vi. full maintenance analysis FMECA as per [51] Appendix D.

3.5.1.2 Scope of work to be performed

It shall include the following:

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

3.5.1.3 Graphical information

Detailed drawings and sketches of the compact switchgear assembly 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 sub-assemblies, are expected as a preferred illustration method. Graphs and similar means of portraying important information shall also be included.

3.5.1.4 Specified operational values

Values and tolerances pertaining to which, when exceeded, make corrective action necessary, e.g.:

i. pressure levels (where applicable);

ii. operating times and contact velocities;

iii. resistance of the main current carrying circuits;

iv. insulating gas characteristics (e.g. the SF6 purity, dew point, acidity);

v. quantities and quality of gas;

vi. contact condition (including contact dimensions);

vii. torque settings for fasteners; and

viii. important dimensions.

3.5.1.5 Standards for materials

This includes warnings of known non-compatibility of materials:

i. fluid; and

ii. cleaning and degreasing agents.

3.5.1.6 Tools, lifting and access equipment

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

3.5.1.7 Tests after the maintenance work

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

3.5.1.8 Spare parts

Description, reference number, quantities and advice for storage.

3.5.1.9 Time estimates

Estimated time required to carry out maintenance activities.

3.5.1.10 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, etc. that are needed to apply them on the circuit-breaker) are part of the special maintenance tools for the circuit-breaker. The manual shall show clearly how the transducer, together with any brackets, fittings, etc. shall be mounted and applied on the circuit-breaker.

3.5.2 Maintenance DVD

It is anticipated that maintenance intervals for the compact switchgear assembly 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 e) a.). 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 DVDs or, if consolidated into a single DVD, there shall be adequate indexing to permit quick access to the desired section. For each piece of equipment requiring maintenance, the DVD shall show:

i. the tools, equipment and materials required to perform the maintenance, especially any special tools;

ii. the tests required prior to maintenance operations to record the status of the equipment and/or to indicate the areas requiring maintenance/readjustment;

iii. the disassembly steps, including any marking of positions required prior to disassembly, any discharging of pressure and/or stored energy;

iv. the disassembly, removal, replacement and reassembly of any sub-components requiring scheduled maintenance/replacement;

v. the reassembly, realignment and reinstallation of all components, including any lubrication of moving parts;

vi. a brief summary of the evacuation, refilling and leak testing of the reassembled equipment;

vii. the testing of the reassembled equipment, including acceptable values and tolerances of the measured/tested parameters; and

viii. 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

The supplier shall provide a list of the minimum recommended spares (refer to 5.19.5) together with prices and unique part numbers in the pricing schedules for the compact switchgear assembly concerned.

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 control-gear.

Spares required under emergency breakdown conditions shall be readily available with a maximum lead time of 24 h 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 h:

i. trip coils;

ii. close coils;

iii. spring charging motors;

iv. disconnector/earthing switch operating motors;

v. auxiliary switches;

vi. gas density monitoring devices; and

vii. contactors and relays.

The supplier shall undertake to supply to Eskom all the necessary replacement parts for the compact switchgear assembly throughout its expected service life. If the manufacture of the specific make and type of compact switchgear assembly (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:

a) all design data;

b) all material characteristics and parameters;

c) all testing information (parameters, equipment, methods, criteria, etc.);

d) all manufacturing information; and

e) 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 compact switchgear assembly 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 3.2.20 0.)

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 and storage of spares

Care shall be taken to ensure that spares are protectively packed for satisfactory long-term storage (a minimum of two years). Spares will usually be stored indoors.

3.5.3.5 DC supply voltage conversion kits

DC 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 DC 110 V to DC 220 V or from DC 220 V to DC 110 V. Refer to 3.1.8 a. and 3.2.17 f.)

3.5.4 Modifications to compact switchgear assembly during their service life

During the normal service life of a compact switchgear assembly supplied, Eskom requires to be notified about any necessary modifications. 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 compact switchgear assemblies supplied to Eskom.

3.5.5 Condition monitoring of circuit-breakers

The supplier is encouraged to develop practical and innovative methods to improve the reliability and maintainability of the compact switchgear assembly installation. This may include online condition monitoring and/or integrated diagnostic devices achieving the following functions:

a) circuit-breaker accumulated interruption amperage values (per pole);

b) contact wear (per pole);

c) continuous measurement of gas density, the instrumentation for which will provide information enabling early warning of gas leaks and planned outages for refilling or repairs;

d) analyser for gas quality and decomposition products (with alarms); and

e) continuous monitoring, recording and alarm signalling of the mechanical operating characteristics of the compact switchgear assembly.

All information required to carry out condition monitoring of compact switchgear assembly (including, but not limited to, standard sheets, speed calculation points, travel curve values) shall be provided by the OEM for each type of compact switchgear assembly. This information shall be given to the Eskom contract manager and relevant technical specialist upon awarding of the contract.

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 3.2.20 n). These manuals shall be in English and provided in the following formats:

a) hard copy A4 form; and

b) electronic copy (PDF) form copied onto an appropriate medium such as 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.

3.6.1.1 Content

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

The manuals shall:

i. be written in English only;

ii. be specifically compiled for the compact switchgear assembly with which they have been supplied;

iii. list torque wrench settings, clearances, settings and other important information, e.g. the typical operating times, speed curves and tolerances in synchronism;

iv. give a clear description of the operation, and the diagrams, photos and description shall be easily read together;

v. give routine inspection, minor and major maintenance procedures, together with a list of lubricants, recommended spares and/or special tools, etc. required for these activities;

vi. contain high-quality diagrams and photos showing details of operating components of the compact switchgear assembly, which also identify and list separately each component making up the diagram;

vii. provide details of the seals and gaskets requiring replacement during overhaul and list the suppliers of these components, together with the part number(s); and

viii. list the names and addresses of suppliers of lubricants, oils, gases, compounds, etc.

One set of sample manuals shall be supplied to Eskom with the tender documentation (refer to 3.2.20 n). and q.) 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):

3.6.1.2 General

i. 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.

ii. Table of contents: the manual shall be sectionalized and numbered sequentially.

iii. Equipment make and type to which the manuals apply.

iv. List of all drawings, by number and title.

v. Description and summary of compact switchgear assembly operation.

vi. Full details of method adopted for anti-pumping.

vii. Details of interlocking provided.

viii. Where applicable, details of auto-reclosing arrangements.

ix. Schematic wiring diagram of compact switchgear assembly.

x. 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.

3.6.1.3 Transport and storage instructions

i. Packaging requirements.

ii. Transport instructions.

iii. Storage instructions: indoor, outdoor and special information for equipment storage.

iv. The measures required to ensure all the manufacturer's transportation and storage requirements are met.

3.6.1.4 Installation instructions

i. Complete step-by-step instructions and detailed drawings, including alignment, installation and dimensional tolerances for preparing the equipment for service.

ii. Inspection procedures before and after unloading, pre-installation tests, gas-filling and monitoring procedures.

iii. The levels of expertise required for the construction team.

iv. A man-hour estimate for the installation work required on site.

v. A list of special equipment and tools required for unloading and positioning components of the circuit-breaker on site.

vi. 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.

3.6.1.5 Testing

i. Functional testing, dielectric testing, controlled switching testing, operating instructions, operating limits and starting-up instructions (complete with sketches or drawings).

ii. A separate set of record sheets, showing measurements and tolerances for each test for separate items of equipment.

3.6.1.6 Inspection and maintenance

The maintenance manual shall contain the typical contents as described in 3.5.1.

3.6.1.7 Dismantling, repair, settings inspection and lubrication

i. Instructions for dismantling the equipment, as well as repair instructions and settings of critical clearances and adjustments, complete with photographs and sketches or drawings.

ii. Special tools shall be clearly described.

iii. Guide to inspection frequency.

iv. All gaskets, seals and O-rings that have to be replaced during scheduled maintenance or after a specified period, shall be identified.

v. Lubrication chart and schedule (including component quantities). Lubricants shall be clearly identified. If no lubrication is required, it shall be clearly stated.

vi. Procedures for the discharge of stored energies in the mechanical and electric systems.

vii. Procedures for the safe disposal of decomposed gas products shall be described.

viii. Trouble-shooting procedures shall be provided.

3.6.1.8 Spare parts

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

ii. Drawings (sectional or 'exploded' views, etc.) of the equipment/sub-assemblies shall identify every component (excluding standard bolts, nuts, washers, etc.) and be referenced to the spare parts list, including component description and manufacturer's part number.

iii. Delivery times for recommended spare parts shall be stated.

3.6.1.9 Drawings for equipment

A complete set of approved drawings, specific to the equipment being supplied. The drawings shall show dimensions and tolerances of the major components and assemblies. Details of the drawings required are given in e) (a.).

3.7 Training

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

Refer to [27] 240-56065202 for the switchgear training requirements from OEMs. The supplier shall provide with the tender documentations, the detailed training programme in accordance with this training standard [27].

3.8 Safety, health, environment and quality

Refer to [29] 240-56063765 for Eskom's health and safety management requirements for suppliers. Refer to [30] QM-58 for Eskom's Supplier Contract Quality Requirements Specification.

3.9 Keywords

Switchgear, circuit-breaker, Air-insulated switchgear (AIS), Gas-insulated Switchgear (GIS), Mixed Technology Switchgear (MTS), outdoor switchgear, control-gear, Current Transformer (CT), dead-tank, gas circuit-breaker, vacuum circuit-breaker, compact, environmental friendly, maintenance analysis, FMECA, digital secondary plant interface.

4. Authorisation

This document has been seen and accepted by:

Name and surname	Designation
	Document Approved by TDAC ROD 13 March 2013 (240-59030436 Rev 1)

5. Revisions

Date	Rev	Compiler	Remarks
May 2015	3	Sphiwe Nkosi	Reviewed clauses:- Clause 2.2, added new reference documents under [43] and [44]; revised the numbering to include [50] to [51]; Clause 3.1.17 – revised; Clause 3.1.20 revised and NOTE c) – added; Clause 3.2.1.1 a) iii. – revised; iv. – added; Clauses 3.2.2.1 b) compartment/ tank metallic enclosure details; Figure 1a, now Figure 1 – showing earthing switch; numbering Fig 1 to Fig 5 and new increasing paragraph numbering i. to v.; Clauses 3.2.2.1 c) – revised; Clause 3.2.4 a) – re-numbered bullet points; Clause 3.2.5 a) – re-numbered bullet points; vi. & vii. – added; Clause 3.2.5 a) – re-numbered bullet points; Clause 3.2.10.1 c) – references 3.3.2 f); Clause 3.2.12 d) – revised referencing; Clause 3.2.12 d) – re-numbered bullet points; Clause 3.2.15 – revised c) and d); Clause 3.2.16 – revised d) and added f) and g); Clause 3.2.17 – added h) with the NOTE and i) and j);

Date	Rev	Compiler	Remarks
			Clause 3.2.17.2 – added NOTE and revised c); Clause 3.2.20 l) and m) – revised; Clause 3.3.1.c) – revised; Clause 3.3.1.3 a) – paragraph revised and introduced i., ii and iii.; Clause 3.7 – revised; Annex A clause A.1 a) – updated with the reference to the Technical Evaluation Criteria and inclusion of i.; Annex A clause A.2 b) – updated with the reference to the Technical Evaluation Criteria; Annex B clause B.2 and B.3 – replace the word tenderer with the word Supplier to be consistent on this document; Annex B clause B.3 Included Deviation schedule for Technical A&B schedule and this Standard – the requirement to submit all technical deviations to the standard; Annex B, Items 2.7 – 2.14 – new items; 2.44 – 2.52 – added numbering; 2.49 and 2.50 – revised; 6.5; 19.48 – revised the reference; Clause 6 – Updated the list with the contributors to this revision; Revised accordingly the clauses that had compact switchgear assemblies to read compact switchgear assembly;
March – May 2014	2	Sphiwe Nkosi	Reviewed clauses:- Clauses 1 and 2.1 – introduced environmental friendliness to align with 240-56063756 Clause 2.1 – introduced FMECA and the option of the digital secondary plant interface; Included standard installations – outdoor; mobile and indoor substations Clause 2.2, corrected numbering; updated [30] – QM-58; Introduced new references [37] to [42],[45] and [48] to [50] Clause 2.3.1 – added IED and PIUs Clause 2.3.2 – added FMECA, ACSI & GOOSE Clause 3.1.5 – new numbering; introduced b) Clause 3.1.14 – added the option of 3 150 A; Clause 3.2.1.1 – added vii. – class of corrosion characterizing the site severity and the material and protection details; Updated numbering x. and xi.; Clause 3.2.2 – Added a “Note” and list; Introduced numbering 3.2.2.1; corrected numbering b) to k) to now b. to o); b) – paragraph revised to CT’s before and after CB, and revised Fig 1, 2 and 3 to now Fig 1a, 1b, 2a, 2b and 3.; d) – revised to > 40 years; h) & Note – environmental friendly medium j) – revised paragraph and introduced n) i. to x.; k) – paragraph revised and introduced o) i. to iii.;

Date	Rev	Compiler	Remarks
			Clause 3.2.4 r) & s) – moved r) to s); r) aligned with 240-56063756; Clause 3.2.6 – revised a) to specify “Marine”; b) included specific “DS”; corrected numbering c) to e); added f) – Material and Corrosion Protection Information; new Table 4; Clause 3.2.8.2 paragraph revised and numbering i. to ii. Clause 3.2.8.3 added a) to d) Clause 3.2.9 b. – updated reference to “Table 5” Clause 3.2.15 Note and d) ii. aligned to 240-56063756 - environmental friendly medium; dew-point details Clause 3.2.17.1 g) introduced the earthing switch interlock requirement Clause 3.2.17.2 and 3.2.17.3 – Requirements of the digital secondary plant interface option Clause 3.2.18 a) introduced iii. Clause 3.3.2 b) x. – corrections; d) i. - introduced Note 1 and re-numbered Note 2; f) updated KIPTS note Clause 3.5 – added maintenance analysis FMECA Clause 3.8 –updated reference; Clause 6; Clause 7; Clause Appendix A, A.1 q) – updated reference
May 2013	1	A. Marais	Document approved for Publication
Nov 2012	0	A. Marais	Draft document for Review created from DSP 34-378

6. Development team

The following people were involved in the development of this document. The original version of this document was prepared by Distribution Technology and Distribution Regions:-

- Sphiwe Nkosi — Technology PDE HV Plant
- Andre Marais — Technology PDE HV Plant
- Deon-Louis Visagie — Distribution – Gauteng OU
- Cobus Busch — Technology PDE DBOUS SI – Gauteng OU
- Peter Almeida — Technology PDE DBOUS SI – Gauteng OU
- Paul Gerber — Technology PDE DBOUS SI– Gauteng OU
- Vinod Singh — Technology PDE DBOUS
- Stefan Terblanche — Technology PDE DBOUS SI – Western Cape OU
- Johan Mostert — Distribution – Western Cape OU
- Alandin Shaikh — HRD
- Zainodabadien Karim — Distribution – Gauteng OU / HRD
- Stuart van Zyl — Technology PDE PTM&C
- Leon Kotze — Technology PDE PTM&C
- Elekanyani Mugivhi — Transmission – Apollo CS

- Gavin Strelec — Sustainability – Research
- Colin Smith — Technology PDE DBOUS
- Rashaad Buffkins — Distribution – Western Cape OU
- Len Ludik — Transmission – HV Plant Southern Grid
- Garth Drake — Sustainability – Research

7. Acknowledgements

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

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 5.20 for documentation requirements), this shall be in paper print, Adobe PDF copy and all the technical schedules A and B shall also be submitted in a copy of the Microsoft Excel format. The tender shall state clearly all deviations (if any) in the Deviation Schedule and in Schedule B (if applicable). Deviations will be evaluated by Eskom and the outcome will be communicated, in writing, to the Tenderer.

   i. The Supplier shall also read the Technical Evaluation Criteria standard 240-87340147 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 240-87340147 shall render the technical submission disqualified for technical evaluation.

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 (South African National Accreditation System (SANAS) accredited, e.g. South African Bureau of Standards (SABS)) or accredited international testing authorities (e.g. KEMA/CESI/IPH).

c) In the case of first-time supply of compact switchgear assembly for use on systems with nominal voltages up to and including 132 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.

d) Ensuring equipment is in an acceptable and safe working condition during all phases of transportation from factory to site, and from storage until the point of official handing over.

e) All necessary arrangements for factory acceptance, transporting and offloading at the most convenient point (if applicable), as well as for transporting and offloading 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) The provision of OEM-accredited installation and pre-commissioning services for all on-site work.

g) The supply of all documentation relevant to the compact switchgear assembly, including routine factory test results. Records shall available during the pre-commissioning (on-site) testing phase.

h) Where applicable, the supply of a fully complete compact switchgear assembly – assembled, installed, pre-commission (on-site) tested and ready for handover (including, where applicable, the first filling of gas to the OEM's rated value).

i) Where necessary (i.e. in the absence of an on-site AC power supply), the supply of an AC 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 compact switchgear assembly, including inter-pole cabling (where applicable) and cabling to the MIB.

m) The supply of all electrical and mechanical interconnections between the elements of the compact switchgear assembly, 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) The supply of the steel support structures for the compact switchgear assembly.

p) 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.

q) Provision of all training in accordance with [28] 240-56065202 for the switchgear training requirements from OEMs.

r) Any OEM modifications required during the compact switchgear assembly service life.

s) 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) and completed Schedule As with the enquiry.

b) The evaluation of all equipment offered and documentation supplied with a tender in accordance with the Technical Evaluation Criteria standard 240-87340147.

c) When required, the assessment and evaluation of the relevant manufacturing facilities.

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).

f) The approval of all other documentation provided by the supplier (e.g. manuals, training material, inspection and testing plans after installation).

g) The supply of a heater connection point for long-term storage.

h) The provision of concrete foundations for the approved compact switchgear assembly steel support structure.

i) The stringing and clamping of main conductors.

j) The supply and installation of the control cabling to the compact switchgear assembly MIB.

k) The supply and installation of all control, metering, relaying and annunciation equipment remote from the compact switchgear assembly.

l) If necessary, the provision of suitable storage facilities where compact switchgear assembly is to be stored for extended durations prior to installation due to unplanned delays.

m) The witnessing and approval of the first complete compact switchgear assembly installation and pre-commissioning.

Annex B – Technical schedules

The schedules attached to this document shall be used when a commercial enquiry is issued. The example of the technical schedule is shown in Appendix B.

B.1 Schedule A

Schedule A lists Eskom's minimum requirements in enquiries and orders. These requirements may include references to the relevant subsections in this standard.

B.2 Schedule B

The Supplier will fill in Schedule B. By doing this, the Supplier will state compliance with this standard and provide the information the purchaser has requested.

B.3 Deviation schedule for Technical A & B Schedule and this Standard

The Supplier will complete a deviation schedule for the Technical A & B and the Standard where the compact switchgear assembly offered deviates.

NOTE:

1) Where this standard allows the purchaser to make a choice, the example of Schedule A (in the model form) lists the preferred items/values/quantities. In the interests of standardization, purchasers are encouraged not to deviate from these preferences.

2) These deviation schedules, when completed, become normative appendixes to the enquiry standard.

SPECIFICATION FOR OUTDOOR MIXED TECHNOLOGY SWITCHGEAR

FOR SYSTEMS WITH NOMINAL VOLTAGES UP TO AND INCLUDING 132 kV

SAP: 0236107 MTGIS Feeder

Schedule A: Purchasers specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

1	2	3		4	5
Item	**Clause of 240-56030436**	**Description**		**Schedule A**	**Schedule B**
1		**Item and system description**			
		MTGIS F SB 132kV 2500A 40kA 31 D6053			
1.1		• SAP No		0236107	xxxxxxxxxx
1.2		• Buyers Guide Drawing		D-DT-6053	xxxxxxxxxx
1.3	3.2.2.1	• Compact switchgear assembly application		Feeder	xxxxxxxxxx
1.4	3.1.1 a)	• Nominal system voltage	kV	132	xxxxxxxxxx
1.5		• System voltage range	pu	0,9 to 1,1	xxxxxxxxxx
1.6	3.2.1.2	• System earthing (effective/non effective)		Non-effective	xxxxxxxxxx
2		**Ratings**			
2.1	3.1.1 a)	• Rated voltage (U_r)	kV	145	
2.2	3.1.1 b)	• Number of phases		3	
2.3	3.1.2	• Rated short-duration power-frequency withstand voltage (U_d)	kV	275/315	
2.4	3.1.2	• Rated peak lightning impulse withstand voltage (U_p)	kV	650/750	
2.5	3.1.3	• Rated frequency (f_r)	Hz	50	
2.6	3.1.4 a.	• Rated normal current (I_r)	A	2500	
2.7	3.1.5	• Calculated maximum continuous current - main circuit @ 40 ^{0}C ambient	A	xxxxxxxxxx	
2.8	3.1.6	• Calculated maximum continuous current - main circuit @ 45 ^{0}C ambient	A	xxxxxxxxxx	
2.9	3.1.7	• Maximum allowable temperature of main contacts (refer to Table 3 of SANS 62271-1)	^{O}C	xxxxxxxxxx	
2.10		• Measured temperature rise (highest) of main contacts @ rated current (type test)	K	xxxxxxxxxx	
2.11	3.1.4 c)	• Maximum allowable temperature of bolted or equiv connections (refer to Table 3 of SANS 62271-1)	^{O}C	xxxxxxxxxx	
2.12	3.1.4 c)	• Measured temperature rise (highest) of bolted or equiv connections @ rated current (type test)	K	xxxxxxxxxx	
2.13	3.1.4 c)	• Maximum allowable temperature of terminals	^{O}C	xxxxxxxxxx	

			for the connection to external conductors (refer to Table 3 of SANS 62271-1)			
2.14	3.1.4 d)	•	Measured temperature rise (highest) of terminals for the connection to external conductors @ rated current (type test)	K	xxxxxxxxxx	
2.15	3.1.4 d)	•	Rated short-time withstand current (I_k and I_{ke})	kA	40	
2.16	3.1.4 d)	•	Rated peak withstand current (I_p and I_{pe})	kA	100	
2.17	3.1.4 d)	•	Rated duration of short circuit (t_k) - main circuit and earthing switch	s	3	
2.18	3.1.4 d)	•	Rated duration of short circuit (t_{ke}) - earthing circuit	s	1	
2.19	3.1.8 a)	•	Rated d.c. supply voltage of closing and opening devices and of auxiliary and control circuits (U_a)	V	110.00	
2.20	3.1.8 b)	•	Rated a.c. supply voltage of heaters and other a.c. auxiliary circuits (U_a)	V	230	
2.21	3.1.8 a)	•	Rated supply frequency of closing and opening devices and of auxiliary and control circuits	Hz	d.c.	
2.22	3.1.9	•	Rated supply frequency of heaters and other a.c. auxiliary circuits	Hz	50	
2.23	3.1.10	•	Rated short-circuit breaking current (I_{SC}) of circuit-breaker	kA	40	
2.24		•	Circuit-breaker class		N/A	
2.25	3.1.11 a)	•	First-pole-to-clear factor (k_{pp}) for circuit-breaker		1,5	
2.26	3.1.11 b)	•	Standard values of TRV related to the rated short-circuit breaking current (SANS 62271-100)		SANS 62271-100 Table 4	
2.27	3.1.12	•	Rated short-circuit making current of circuit-breaker and earthing switch	kA	100	
2.28	3.1.13	•	Rated operating sequence for circuit-breaker		O-0,3s-CO-3m-CO	
2.29	3.1.13 d)	•	Minimum resting time following rated operating sequence	min	xxxxxxxxxx	
2.30	3.1.14	•	Characteristics for short-line faults		SANS 62271-100 4.105 for Class S2 circuit-breakers	
2.31	3.1.15	•	Rated out-of-phase making and breaking current for circuit-breakers	kA	xxxxxxxxxx	
2.32	3.1.16 a)	•	Classification of circuit-breaker according to its restrike performance (line- and cable-charging breaking current)		Class C2	
2.33	3.1.16 b)	•	Rated capacitive switching currents for circuit-breaker - line-charging breaking current	A	50	
2.34	3.1.16 b)	•	Rated capacitive switching currents for circuit-breaker - cable-charging breaking current	A	160	
2.35	3.1.16 b)	•	Classification of circuit-breaker according to its restrike performance (capacitor bank breaking current)		xxxxxxxxxx	
2.36	3.1.16 b)	•	Rated capacitive switching currents for circuit-breaker - single capacitor bank	A	400	

		breaking current				
2.37	3.1.16 b)	•	Rated capacitive switching currents for circuit-breaker - back-to-back capacitor bank breaking current	A	400	
2.38	3.1.16 b)	•	Rated capacitive switching currents for circuit-breaker - back-to-back capacitor bank inrush making current	kA	20	
2.39	3.1.17	•	Inductive load switching for circuit-breaker		xxxxxxxxxx	
2.40	3.1.17	•	Chopping number of the circuit-breaker	λ	xxxxxxxxxx	
2.41	3.1.18	•	Rated opening time for circuit-breaker	ms	xxxxxxxxxx	
2.42	3.1.18	•	Rated break-time for circuit-breaker	ms	xxxxxxxxxx	
2.43	3.1.18	•	Rated closing time for circuit-breaker	ms	xxxxxxxxxx	
2.44	3.1.18	•	Rated open-close time for circuit-breaker	ms	xxxxxxxxxx	
2.45	3.1.18	•	Rated reclosing time for circuit-breaker	ms	xxxxxxxxxx	
2.46	3.1.18	•	Rated close-open time for circuit-breaker	ms	xxxxxxxxxx	
2.47	3.1.18	•	Rated pre-insertion time for circuit-breaker	ms	N/A	
2.48	3.1.19 & 3.1.20	•	Circuit-breaker mechanical endurance class		Class M2	
2.49	3.1.19 & 3.1.20	•	Number of mechanical operations for circuit-breaker		10000	
2.50	3.1.19 & 3.1.20	•	Disconnector mechanical endurance class		Class M2/ (Class M1 *)	
2.51	3.1.19 & 3.1.20	•	Number of mechanical operations for disconnector		10000/ (2000*)	
2.52	3.1.20	•	Classification of circuit-breakers as a function of electrical endurance		N/A	
3	3.2.1	**Service conditions**				
3.1	3.2.1.1	•	Location	(indoors/ outdoors)	Outdoors	
3.2	3.2.1.1	•	Ambient air temperature range	°C	-10 to +45	
3.3	3.2.1.1	•	Solar radiation	W/m^2	up to 1100	
3.4	3.2.1.1	•	Altitude (amsl)	m	up to 1800	
3.5	3.2.1.1	•	Class of pollution (SANS 60815-1:2009)		Very heavy ('e')	
3.6	3.2.1.1	•	Average humidity	%	up to 95	
3.7	3.2.1.1	•	Wind speed	m/s	up to 34	
3.8	3.2.1.1	•	Condensation and precipitations		Yes	
3.9	3.2.1.1	•	Seismic activity	g	0,3	
4	3.2.2	**General**				
4.1		•	Compact switchgear assembly manufacturer		xxxxxxxxxx	
4.2		•	Compact switchgear assembly country of origin		xxxxxxxxxx	
4.3		•	Compact switchgear assembly model/type designation		xxxxxxxxxx	
4.4	3.2.20 b) viii.	•	Compact switchgear assembly total mass	kg	xxxxxxxxxx	
4.5	3.2.2.1 a)	•	Compact switchgear assembly compliant to SANS 62271-205		Yes	
4.6	3.2.2.1 b)	•	Type of design in accordance with SANS 62271-205		Dead-tank compact "type	

				3"	
4.7	3.2.2.1 c)	•	Steel support structure supplied with switchgear Yes/No	Yes	
4.8	3.2.2.1 d)	•	Insulating medium	xxxxxxxxxx	
4.9	3.2.2.1 d)	•	Minimum expected life-span years	> 40 years	
4.10	3.2.2.1 e)	•	Circuit-breaker compliant to SANS 62271-100	Yes	
4.11		□	- Circuit-breaker manufacturer	xxxxxxxxxx	
4.12		□	- Circuit-breaker country of origin	xxxxxxxxxx	
4.13		□	- Circuit-breaker model/type designation	xxxxxxxxxx	
4.14	3.2.2.1 f) i.	□	- Circuit-breaker pole operation	3-pole operated	
4.15	3.2.2.1 f) ii.	□	- Stored energy operation for circuit-breaker mechanism	Yes	
4.16	3.2.2.1 f) ii.	□	- Energy storage device	Spring	
	3.2.2.1 f) ii. Note	□	**NOTE:** When a feeder circuit-breaker 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		
4.17	3.2.2.1 f) ii.	□	- Manual and motorised spring charging	Yes	
4.18	3.2.2.1 f) ii.	□	- Manual and electric energy release	Yes	
4.19	3.2.2.1 h)	□	- Circuit-breaker interrupting technology (Vacuum/SF_6)	xxxxxxxxxx	
4.20	3.2.2.1 h)	□	- Circuit-breaker type of interrupter design (e.g. puffer, self-blast, etc.)	xxxxxxxxxx	
4.21	3.2.2.1 h)	□	- Circuit-breaker configuration of the moving contacts (e.g. single, double or triple motion design)	xxxxxxxxxx	
4.22	3.2.2.1 i)	•	Disconnector/earthing switches compliant to SANS 62271-102	Yes	
4.23	3.2.2.1 i)	•	Type of disconnector offered (e.g. three position)	xxxxxxxxxx	
4.24	3.2.2.1 j)	•	Mechanical interlocking (including padlocking) devices provided in accordance with SANS 62271-203	Yes	
4.25	3.2.2.1 k)	•	Padlocking facilities suitable for padlocks with a shackle diameter of 6 mm	Yes	
4.26	3.2.2.1 m)	•	Gas-filled enclosures and partitions in accordance SANS 62271-203	Yes	
4.27	3.2.2.1 n) i. to ix.	•	Earthing of gas-filled enclosures in accordance with SANS 62271-203, with Eskom requirements included	Yes	
4.28	3.2.2.1 o) i. to iii.	•	Compact switchgear assembly supplied with integrated ring-type CTs and Eskom requirements included	Yes	
		□			
5	3.2.3	**Construction Requirements**			

5.1	3.2.3 a) to d)	• Construction and design in accordance with 3.2.3 also sub-clauses a) to d)		Yes	
6	3.2.4	**Operating mechanism enclosure requirements**			
6.1	3.2.4 a)	• Operating mechanisms, local control facilities and all parts requiring lubrication protected by weatherproof enclosures	Yes/No	Yes	
6.2	3.2.4 a) i.	- degree of protection for enclosures containing exposed bearings, auxiliary switches, motors and other electrical devices	IP	IP 55	
6.3	3.2.4 a) ii.	- degree of protection for all open areas in the circuit-breaker common base frame as well as externally mounted indicating devices (where applicable)	IP	IP 2X	
6.4	3.2.4 a) iii.	- degree of protection for all other enclosures	IP	IP 54	
6.5	3.2.4 b)	• Operating mechanism enclosure material		3CR12 / Stainless steel/ Aluminium	
6.6	3.2.4 b)	• Operating mechanism enclosure corrosion protection in accordance with 3.2.6 of 240-56030436	Yes/No	Yes	
6.7	3.2.4 c)	• Operating mechanism enclosures arranged to facilitate easy access from all sides	Yes/No	Yes	
6.8	3.2.4 c)	- all fastenings compliant with 240-56030436	Yes/No	Yes	
6.9	3.2.4 d)	• Circuit-breaker designed for operation from the font of the operating mechanism enclosure	Yes/No	Yes	
6.10	3.2.4 e)	• Access to the operating mechanism controls, components, secondary terminals strips etc. provided through hinged front access door	Yes/No	Yes	
6.11	3.2.4 f) & 3.2.20 b) iv.	• Maximum height to top of mechanism enclosure equipment requiring access for servicing at ground level and shown on drawing	Yes/No	2000	
6.12	3.2.4 g)	• Front access door secured with a heavy-duty locking mechanism	Yes/No	Yes	
6.13	3.2.4 h)	• Padlocking facility shackle diameter	Yes/No	6	
6.14	3.2.4 i)	• Front access door equipped with travel stop	Yes/No	Yes	
6.15	3.2.4 j)	• Steel documentation pocket provided on inside of front access door	Yes/No	Yes	
6.16	3.2.4 k)	• Facilites provided for securing operating tools on inside of front access door	Yes/No	Yes	
6.17	3.2.4 l)	• Earthing of operating mechanism enclosure in accordance with 240-56030436	mm	Yes	
6.18	3.2.4 m) & 3.2.17.1 c) & d)	• Provision for bottom entry of all control cabling into a common MIB	Yes/No	Yes	
6.19	3.2.4 n)	• Metallic cable racking provided for inter-pole cabling?	Yes/No	No	

6.20	3.2.4 o)	• Upper surfaces of enclosure shaped/sloped to prevent the accumulation of water	Yes/No	Yes	
6.21	3.2.4 p)	• Gasket material offered		Neoprene / Nitrile rubber/ Cork	
6.22	3.2.4 q)	• Gauze-covered drain hole provided (> 25 mm)	Yes/No	Yes	
6.23	3.2.4 r)	• Enclosure lifting eyes provided		Top	
6.24	3.2.4 s)	• Enclosure colour		Light grey (G29)	
7	3.2.5	**Compact switchgear assembly supporting structure**			
	3.2.5 a)	• Mechanical loads and parameters relating to the design of the support structure and foundation			
7.1	3.2.5 a) i.	- “static” dead weight of the compact switchgear assembly	N	xxxxxxxxxx	
7.2	3.2.5 a) ii.	- rated “static” terminal force F_{shA} of the compact switchgear assembly due to connected conductors	N	xxxxxxxxxx	
7.3	3.2.5 a) ii.	- rated “static” terminal force F_{shB} of the compact switchgear assembly due to connected conductors	N	xxxxxxxxxx	
7.4	3.2.5 a) ii.	- rated “static” terminal force F_{sv} of the compact switchgear assembly due to connected conductors	N	xxxxxxxxxx	
7.5	3.2.5 a) iii.	- “dynamic” horizontal force exerted during operation on the foundation	N	xxxxxxxxxx	
7.6	3.2.5 a) iv.	- “dynamic” vertical force exerted during operation on the foundation	N	xxxxxxxxxx	
7.7	3.2.5 a) v.	- “dynamic” moment (torque) exerted during operation about the foundation	Nm	xxxxxxxxxx	
7.8	3.2.5 a) vi.	- “dynamic” horizontal force exerted between poles (centre phase interrupter chamber) during a rated (terminal fault) short-circuit	N	xxxxxxxxxx	
7.9	3.2.5 a) vii.	- wind force (load) exerted on the compact switchgear assembly	N	xxxxxxxxxx	
7.10	3.2.5 a) vii.	- maximum torque required for the foundation holding down bolt nuts	Nm	xxxxxxxxxx	
7.11	3.2.5 b)	• Compact switchgear assembly steel support structure to be designed by manufacturer	Yes/No	Yes	
7.12	3.2.5 c)	• Circuit-breaker concrete foundation to be designed by manufacturer	Yes/No	Yes	
7.13	3.2.5 d) & 3.2.20 b)	• Drawing showing steel support structure and concrete foundation design details		xxxxxxxxxx	
7.14	3.2.5 e)	• Provision for the on-site fitting of at least one Eskom “type 2” fiberglass electrical equipment label in accordance with D-DT-5047 (sheets 2 and 4).	Yes/No	Yes	
8	3.2.6	**Corrosion protection and lubrication**			
8.1	3.2.6 a)	• Corrosion specification		DSP 34-1658	

8.2	3.2.6 a)	• Corrosivity rating of environment		"high" to "very high", 'C4' and 'C5' i.e. Marine	xxxxxxxxxx
8.3	3.2.6 b)	• Minimum detailed specification number for exposed metal	DS	DS-11	xxxxxxxxxx
8.4	3.2.6 c)	- Equivalent detailed specification number offered for all bolts, nuts and washers	DS	xxxxxxxxxx	
8.5	3.2.6 c)	- Equivalent detailed specification number offered for all structural steel	DS	xxxxxxxxxx	
8.6	3.2.6 c)	- Equivalent detailed specification number offered for all other exposed metal (excluding main terminals)	DS	xxxxxxxxxx	
8.7	3.2.6 d)	• Details of lubricants provided with tender documentation including the list of equivalent lubricants from South African sources	Yes/No	Yes	
8.8	3.2.6 e)	• Details of flange arrangements, treatments to prevent flange corrosion provided with tender	Yes/No	Yes	
8.9	3.2.6 f)	Material and Corrosion Protection Information provided	Yes/No	Yes	
9	3.2.7	**Compact switchgear assembly operating mechanism enclosure heaters**			
9.1	3.2.7 a)	• Heater size offered	Watt	xxxxxxxxxx	
9.2	3.2.7 d)	• Heater control and alarm circuit standard, also wired to Eskom standard drawing		240-56030489 & D-DT-5409	
10	3.2.8	**Interface requirements**			
10.1	3.2.8.1	• HV main terminal type		Flat pad	
10.2		- Number of holes and pitch	mm	8 x 50	
10.3		- Thickness (min)	mm	20	
10.4		- Material		Aluminium	
	3.2.8.2	• Earthing terminals			
10.5		- Provision for the on-site fixing of ball joint assemblies on the steel support structure	Yes/No	Yes	
	3.2.8.3	• Cable connections			
10.6		- Provision for the connection of cables in accordance with SANS 62271-209	Yes/No	No	
10.7	3.2.8.3 c)	- The cable end unit has the facility of a permanent nature for HV and insulation testing of cable on site	Yes/No	Yes	
11	3.2.9	**Safety clearances and personnel safety**			
11.1	3.2.9 a)	• Live parts isolated by means of elavation	Yes/No	Yes	
11.2	3.2.9 b)	• Electrical working clearance (min) in accordance to OHS Act No. 85 of 1993	mm	3950	
11.3	3.2.9 c)	• Distance from lowest part of any high-voltage insulation above ground shall not be less than	mm	2500	
11.4	3.2.9 d)	• Type of pressure relief devices provided		xxxxxxxxxx	
12	3.2.10	**Insulation requirements**			

	3.2.10.1	• Bushings			
12.1	3.2.10.1 a)	- Insulator material		Silicone rubber composite	
12.2	3.2.10.1 a)	- Insulator manufacturer		xxxxxxxxxx	
12.4	3.2.10.1 b)	- Silicone rubber composite type insulators in accordance with SANS 60137, SANS 61462 and SANS 60815-3	Yes/No	Yes	
12.5	3.2.10.1 c)	- Compact switchgear assembly tested at KIPTS	Yes/No	Yes	
	3.2.10.2 a)	• Minimum insulation creepage distances (SANS 60815-1)			
12.6	3.2.10.2 a)	- Minimum external unified specific creepage distance	mm/kV	53,7	
	3.2.10.3	• Clearances in air			
12.7	3.2.10.3	- Phase to phase clearance in air	mm	xxxxxxxxxx	
12.8	3.2.10.3	- Phase to earth clearance in air	mm	xxxxxxxxxx	
13	3.2.11	**Padlocking facilities**			
13.1	3.2.11 a)	• Facilities provided to padlock the following: - compact switchgear assembly in the OFF, ON and EARTH positions;		Yes	
13.2	3.2.11 b)	• Padlocking facilities provided to prevent the selection of the ON position while permitting operation from OFF to EARTH or from the EARTH to OFF positions		Yes	
14	3.2.12	**Motorised disconnector/earthing switches**			
14.1	3.2.12 a)	• Disconnector/earthing switches motorised	Yes/No	Yes	
14.2	3.2.12 b)	• Continuous power rating of motor	W	≤ 100	
14.3	3.2.12 b)	• Total operating time	s	xxxxxxxxxx	
14.4	3.2.12 c)	• Motorised disconnector/earthing switch circuit and wiring requirements		240-56030489 and D-DT-5409	
14.5	3.2.12 d)	• Local control push-buttons provided in accordance with 240-56030436	Yes/No	Yes	
14.6	3.2.12 f)	• Manual operation of disconnector/earthing switch possible in the event of an emergency	Yes/No	Yes	
15	3.2.13	**Position / status indication**			
15.1	3.2.13.1 a)	• Mechanical mimic indicating the ON, OFF and EARTH positions of the main circuit provided		Yes	
15.2	3.2.13.1 b)	- mimic location		xxxxxxxxxx	
15.3	3.2.13.1 c)	• Definite mechanical position / status indications coupled directly to operating mechanism / drive shaft provided for:		Yes	
15.4	3.2.13.1 c) i.	- circuit-breaker contact status (open/closed)		Yes	

15.5	3.2.13.1 c) ii.	☐	- disconnector status (open/closed/earthing – as and where applicable)	Yes	
15.6	3.2.13.1 c) iii.	☐	- earthing switch status (open/earthed)	Yes	
15.7	3.2.13.1 d)	•	Switching device mechanical position indication		
15.8	3.2.13.1 d) i.	☐	- Closed position: “I” in white lettering on a red background	Yes	
15.9	3.2.13.1 d) ii.	☐	- Open position: “O” in white lettering on a green background	Yes	
15.10	3.2.13.1 d) iii.	☐	- Earthed position: (the earth symbol) in black on a yellow background	Yes	
15.11	3.2.13.1 e)	☐	- Lettering (symbol) size (min) mm	15	
15.12	3.2.13.1 f)	•	Circuit-breaker closing spring status indicated by "SPRING CHARGED" and "SPRING DISCHARGED"	Yes	
15.13	3.2.13.1 g)	•	Type of non-resettable circuit-breaker operation counter offered	Mechanical / electrical	
15.14	3.2.13.1 h)	•	Position / status indicators visible and legible by persons standing at ground level	Yes	
15.15	3.2.13.1 i)	•	Method offered to view disconnector main contact status (e.g. viewing aperture / porthole)	xxxxxxxxxx	
15.16	3.2.13.2	•	Main circuit live indication provided	SANS 61243-5	
15.17	3.2.13.3	•	Gas density gauges provided for the compact switchgear assembly (where applicable) and sheltered from the elements	Yes	
		☐			
16	3.2.14	**Labels**			
	3.2.14 a)	•	Operating labels		
16.1		☐	- Instructions for mechanically tripping and closing the circuit-breaker: titled 'TO TRIP CIRCUIT-BREAKER' and 'TO CLOSE CIRCUIT-BREAKER' respectively	Yes	
16.2		☐	- Instructions for charging circuit-breaker closing spring, titled ‘TO CHARGE SPRING’ locatd near actuator for local mechanical spring charging	Yes	
16.3		☐	- Instructions for earthing the cable and busbar (as applicable), titled ‘TO ISOLATE AND EARTH MAIN CIRCUIT’	Yes	
	3.2.14 b)	•	Actuators		
16.4		☐	- Actuator(s) for local opening and closing of the switching devices labelled in accordance with 240-56030436 and 240-56062515?	Yes	
	3.2.14 e)	•	Function labels		
16.5		☐	- Function labels provided to identify all LV equipment	Yes	
16.6		☐	- Function label text hieght (min) mm	> 5	

16.7	3.2.14 f)	• Labels manufactured to 240-56062515 (unless otherwise specified or agreed)		Yes	
16.8	3.2.14 f)	• Method of attachment of labels		xxxxxxxxxx	
17	3.2.15 & Note	**Requirements for gas-filled compartments (where applicable)**			
17.1	3.2.15 a)	• - Gas-filled compartments factory gas-filled and tested with new gas at rated transportation pressure		Yes	
17.2		• - period to replenishment of the gas	years	> 40	
17.3	3.2.15 b)	• - maximum gas leakage rate per year	%	xxxxxxxxxx	
17.4	3.2.15 b)	• - quantity of gas required for compact switchgear assembly	kg	xxxxxxxxxx	
17.5	3.2.15 b)	• - quantity of gas required for circuit-breaker compartment (if applicable)	kg	xxxxxxxxxx	
17.6	3.2.15 b)	• - quantity of gas required for disconnector/earthing switch compartment (if applicable)	kg	xxxxxxxxxx	
17.7	3.2.15 c)	• - SF6 gas in accordance with IEC 60376 and certificate provided		Yes	
17.8	3.2.15 e) i.	• - gas filling/evacuation point provided for each gas-filled compartment		DILO DN8	
17.9	3.2.15 e) ii.	• - access to gas filling/evacuation point < 2400 mm high		Yes	
17.10	3.2.15 e) iii.	• - gas filling/evacuation point and gas pressure gauge separated		Yes	
17.11	3.2.15 e) iv.	• - dial type gauge responding to gas density and indicating pressure compensated for temperature provided for compact switchgear assembly		Yes	
17.12		• - type of gauge offered		xxxxxxxxxx	
17.13	3.2.15 e) v.	• - gas density monitoring device (density switch) provided with contacts in accordance with 240-56030489		Yes	
17.14	3.2.15 e) vi.	• - Electrical interlocks and alarms provided by the gas density monitoring device in accordance with 240-56030489		Yes	
17.15	3.2.15 e) ix. & x.	• - method used to prevent corrosion of moving parts		Yes	
17.16	3.2.15 e) xii.	• - non-return valves fitted on all DN8 fittings and pipework		Yes	
17.17	3.2.15 e) xiii.	• - pipework and cabling mechanically protected		Yes	
17.18	3.2.15 f)	• - where applicable, the management of SF6 gas shall be in accordance with [5] NRS 087		Yes	
18	3.2.16	**Current Transformers (D-DT-5409)**			
18.1	3.2.16 a)	• Dry type current transformers to SANS 60044-1		Yes	

18.2	3.2.16 a)	• Make (manufacturer) of CT offered		xxxxxxxxxx	
18.3	3.2.16 a)	• Type of CT offered		xxxxxxxxxx	
18.4	3.2.16 b)	• CT specification (drawing number)		240-56030489 & D-DT-5409	
18.6	3.2.18 c) & 3.2.16 c)	• Position relative to the circuit-breaker shown on nameplate, and metering core not underneath heavy protection core		D-DT-5409	
18.7	3.2.16 d)	• Terminal numbering		D-DT-5409	
		• Protection current transformers:			
18.8	3.2.16 b)	□ a) cores		D-DT-5409	
18.9	3.2.16 b)	□ b) class		D-DT-5409	
18.10	3.2.16 b)	□ c) ratios		D-DT-5409	
		• Bus-zone current transformers:			
16.11	3.2.16 b)	□ a) cores		D-DT-5409	
16.12	3.2.16 b)	□ b) class		D-DT-5409	
16.13	3.2.16 b)	□ c) ratios		D-DT-5409	
		• Measurement current transformers:			
18.11	3.2.16 b)	□ a) cores		D-DT-5409	
18.12	3.2.16 b)	□ b) class		D-DT-5409	
		□ NOTE Measurement cores to be dual rated on specified ratios			
18.13	3.2.16 b)	□ c) burden	VA	D-DT-5409	
18.14	3.2.16 b)	□ d) ratios	A	D-DT-5409	
		□			
19	3.2.17	**Auxiliary and control circuits (see 240-56030489 & D-DT-5409)**			
19.1	3.2.17.1 a)	• Auxiliary and control circuits to 240-56030489 and D-DT-5409		Yes	
		• Auxiliary power supplies:			
19.2		□ - Provision		On site by Eskom	
19.3		□ - Peak power requirement for compact switchgear assembly (max)	VA	xxxxxxxxxx	
19.4		□ - Standby power requirements for compact switchgear assembly	VA	xxxxxxxxxx	
		• Circuit-breaker spring-charging motor control circuit:			
19.5		□ - d.c. supply voltage range of operation	%	85 to 110	
19.6		□ - d.c. power (peak)	W	≤ 1000	
19.7		□ - d.c. power (continuous)	W	≤ 100	
19.8		□ - total time taken to charge spring	s	≤ 10	

19.9		☐	- method offered for protection against continual motor running (over-run)		xxxxxxxxxx	
19.10		☐	- automatic charging of closing spring		Yes	
19.11		☐	- number of spare contacts of SLS provided		240-56030489 & D-DT-5409	
		•	Motorised disconnector/earthing switch circuit:			
19.12		☐	- d.c. supply voltage range of operation	%	85 to 110	
19.13		☐	- d.c. power (peak)	W	xxxxxxxxxx	
19.14		☐	- d.c. power (continuous)	W	≤ 100	
19.15		☐	- total time taken to operate disconnector/earthing switch	s	xxxxxxxxxx	
19.16		☐	- method offered for protection against continual motor running (over-run)		xxxxxxxxxx	
		•	Circuit-breaker closing control circuit:			
19.17		☐	- d.c. supply voltage range of operation	%	85 to 110	
19.18		☐	- d.c. power (peak)	W	≤ 500	
19.19		☐	- number of close coils required		1	
19.20		☐	- close coil current	A	xxxxxxxxxx	
19.21		☐	- close coil resitance @ 20^0C	Ω	xxxxxxxxxx	
		•	Circuit-breaker tripping control circuit:			
19.22		☐	- d.c. supply voltage range of operation	%	70 to 110	
19.23		☐	- d.c. power (peak)	W	≤ 500	
19.24		☐	- number of trip coils required		2	
19.25		☐	- physically and electrically separate trip control circuits		Yes	
19.26		☐	- trip circuit supervision		Yes	
19.27		☐	- trip coils rated to carry 20mA d.c. continuously		Yes	
19.28		☐	- trip coil current	A	xxxxxxxxxx	
19.29		☐	- trip coil resistance @ 20^0C	Ω	xxxxxxxxxx	
19.30		•	Circuit-breaker equipped with anti-pumping circuitry		Yes	
19.31		•	Circuit-breaker control circuit interlocks provided in accordance with 240-56030489		Yes	
19.32		•	Alarm circuits provided and wired in accordance with 240-56030489 and D-DT-5409		N/A	
		•	Auxiliary contacts provided (spare for Eskom use):			
		☐	Duty rating			
19.33		☐	- a.c. and d.c. supply current	A	10	
19.34		☐	- N/O and N/C contact reference positions		Circuit-breaker opened, spring discharged, busbar and cable earthing switches not applied, disconnector in closed position	
		☐	Low gas alarm contacts (spare)			
19.35		☐	- N/O		0	

19.36		☐	- N/C		2	
		☐	Low gas block contacts (spare)			
19.37		☐	- N/O		0	
19.38		☐	- N/C		2	
		☐	Circuit-breaker auxiliary switch contacts (spare)			
19.39		☐	- N/O		4	
19.40		☐	- N/C		4	
		☐	Circuit-breaker spring limit switch contacts (spare)			
19.41		☐	- N/O		2	
19.42		☐	- N/C		2	
		☐	Earth switch applied (spare)			
19.43		☐	- N/O		1	
19.44		☐	- N/C		0	
		☐	Disconnector open position			
19.45		☐	- N/O		1	
		☐	Disconnector closed position			
19.46		☐	- N/C		1	
		•	Terminal blocks and terminal strips:			
19.47		☐	- Number of spare terminals provided		≥ 6	
19.48		☐	- Terminal blocks to 240-70413291, screw clamp, spring-loaded insertion type		Yes	
19.49		☐	- Terminal block width offered	mm	≥ 8	
19.50		☐	- Make of terminal block offered		xxxxxxxxxx	
19.51		•	Lugs (insulated hook blade type)		Crimped	
19.52		•	Earth sliding link types/equivalents		Weidmuller TVP SAKA 10	
19.53		•	Trunking provided at top and bottom of each terminal rail		Yes	
19.54		•	'Fine-tooth' trunking tooth width	mm	6,1	
19.55		•	Trunking size	mm	60 x 60	
		•	Wiring size:			
19.56		☐	- CT and motor control circuit wires (min)	mm^2	2,5	
19.57		☐	- Control and other auxiliary wires (min)	mm^2	1,5	
19.58		☐	- Minimum number of strands		7	
		•	Wiring colour:			
19.59		☐	- CT wires		red/white/blue/black	
19.60		☐	- Earth wires		green/yellow	
19.61		☐	- All other wires		grey	
19.62		•	Wiring identification		Ferruling	
19.63		•	Terminal strips in accordance with 240-56030489 - located in MIB		Yes	
		•	LV MCBs:			
19.64		☐	- MCBs to SANS 60947-2 and IEC 60898		Yes	
19.65		☐	- Make and type offered		xxxxxxxxxx	
19.66		☐	- I_{CU}	kA	xxxxxxxxxx	
19.67		☐	- I_{CS}	kA	xxxxxxxxxx	
19.68		☐	- Utilisation category (SANS 60947-2)		'A'	

19.69		☐	- Max service voltage V	xxxxxxxxxx	
19.70		☐	- d.c. MCB rated voltage V	≥ 250	
19.71		☐	- Pollution degree (SANS 60947-2)	≥ 3	
19.72		☐	- Suitable for isolation (SANS 60947-2)	Yes	
19.73		☐	- Protection curve (SANS 60947-2 / IEC 60898)	'C'	
19.74		☐	- Location	MIB	
19.75	3.2.17.1 c)	•	LV gland plate provided in accordance with 240-56030436 and 240-56030489?	Yes	
19.76	3.2.17.1 d)	•	Provision for the entry of all Eskom low voltage control cables to one marshalling interface box (MIB)	Yes	
19.77	3.2.17.1 d)	•	Terminal strips positioned and spaced to provide easy access to the terminals to insert the wiring	Yes	
19.78	3.2.17.1 e)	•	Earthing point provided in accordance with 240-56030436?	Yes	
19.79	3.2.17.1 f)	•	Possible to change the d.c. control voltage in accordance with 240-56030436?	Yes	
		☐			
20	3.2.18	**Nameplates**			
		•	Nameplates provided for the following:		
20.1	3.2.18 a)	☐	- compact switchgear assembly (IEC 62271-205)	Yes	
20.2	3.2.18 c) & 3.2.16 a)	☐	- CTs (IEC 60044-1)	Yes	
20.3	3.2.18 c)	•	Duplicate nameplates provided in MIB for CTs	Yes	
20.4	3.2.18 e)	•	Method of attachment of nameplate	xxxxxxxxxx	
20.5	3.2.18 e)	•	Namplate material offered	xxxxxxxxxx	
		☐			
21	3.2.19	**Tools and spares**			
		•	Tools to be supplied with compact switchgear assembly (minimum requirements):		
21.1	3.2.19 a)	☐	- full set of operating tools (provide list on separate sheet provided) Sets	1 set per switchboard	
21.4	3.2.19 c)	•	Standard tools available for minor maintenance (provide list on separate sheet provided)	Yes	
21.5	3.2.19 d)	•	Specialised tools available for major maintenance purposes (provide list on separate sheet provided)	Yes	
21.6	3.2.19 d) & 3.2.20 h)	•	Spares available for maintenance (provide list on separate sheet provided)	Yes	
		☐			
22	3.2.20	**Documentation**			
	3.2.20 r)	**Note: All tender documentation to be provided in electronic format.**			

	3.2.20 a) & b)	• Documentation to be supplied with tender:				
22.1		☐ - GA drawing (provide drawing number on separate sheet provided)	Sets	1		
22.2		☐ - Drawing showing bushing profile (provide drawing number on separate sheet provided)	Sets	1		
22.3		☐ - Generic layout of nameplates (provide drawing number on separate sheet provided)	Sets	1		
22.4		☐ - Generic auxiliary and control circuit schematic wiring diagram	Sets	1		
22.5		☐ - GA drawing of the MIB (provide drawing number on separate sheet provided)	Sets	1		
22.6		☐ - list of all operating tools (provide list on separate sheet provided)	Sets	1		
22.7		☐ - list of all standard minor maintenance tools (provide list on separate sheet provided)	Sets	1		
22.8		☐ - list of all specialised major maintenance tools (provide list on separate sheet provided)	Sets	1		
22.9		☐ - full list of spares required for maintenance (provide list on separate sheet provided)	Sets	1		
22.1		☐ - full list of type tests as well as copies of type test respors and/ or certificates- (provide report numbers on separate sheet provided)	Sets	1		
22.11		☐ - generic routine test certificates for each panel type	Sets	1		
22.12		☐ - transport, storage, installation, operating and maintenance manuals	Sets	1		
22.13		☐ - training material	Sets	1		
22.14		☐ - all other relevant additional information requested	Sets	1		
	3.2.20 r)	• Documentation to be supplied with each compact switchgear assembly:				
22.15		☐ - Schematic wiring diagram	Sets	1		
22.16		☐ - Complete set of routine test certificates	Sets	1		
22.17		☐ - Commissioning and hand-over test sheet	Sets	1		
22.18		☐ - Transport, storage, installation, operating and maintenance manuals	Sets	1		
22.19		• Units used in Republic of South Africa		In tender/offer		
22.2		• Project reference list, service to Eskom		In tender/offer		
		☐				
23		**Miscellaneous**				
		• General				
23.1		☐ Guarantee period	Years	xxxxxxxxxx		
23.2		☐ Required period for spares availability	Years	25 years after discontinuation of switchgear		
23.3	3.2.21	☐ Packaging in accordance with 240-56030436	Yes/No	Yes		
24	3.7	**Training Requirements**				
24.1		• Training offered in accordance with 240-	Yes/No	Yes		

		56065202		

SIGNATURES

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

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.

Table D.6: FMECA Worksheet

FMEA									Criticality (Risk) Assessment																				Outcome
Ref	Function / item	Failure mode	Failure mechanism / cause	Failure effects: Local	Failure effects: Next Higher	Failure effects: End	Detection method	Compensating provisions	Usage, Environment and Health	High / Harsh / Good				Low / Harsh / Good				High / Mild / Good				Low / Mild / Good				High / Harsh / Poor				Low / Harsh / Poor				High / Mild / Poor				Low / Mild / Poor				Maintenance Determination / Recommendation
									Functional Importance	Critical	Significant	Economic	Run to failure	Critical	Significant	Economic	Run to failure	Critical	Significant	Economic	Run to failure	Critical	Significant	Economic	Run to failure	Critical	Significant	Economic	Run to failure	Critical	Significant	Economic	Run to failure	Critical	Significant	Economic	Run to failure	Critical	Significant	Economic	Run to failure	
1.1	Pressure sensor, number XYZ	No output	Mechanical or electrical damage	No pressure input to analogue-to-digital converter	Control system inhibits start-up sequence	No effect	Control system start-up test function	Visual alarm on operator console/ redundant sensor	Probability[1]	D				C				D				B				C				B				C				A				None
									Consequence[2]																																		
									Risk[3]																																		
1.2	Pressure sensor, number XYZ	Out of range output	Electrical damage	Out of range pressure input to analogue-to-digital	Control system initiates shutdown sequence	Over-pressure of vessel possible	Control system continuous test function	Visual and audible alarm on operator console	Probability[1]	E				E				E				E				E				E				E				E				
									Consequence[2]																																		
									Risk[3]																																		
1.3	Pressure sensor, number XYZ	Inaccurate output	Electrical damage	Inaccurate pressure input to analogue-to-digital converter	Incorrect control of pressure system	Over or under-pressure of vessel possible	None	None	Probability[1]																																		
									Consequence[2]																																		
									Risk[3]																																		

Table D.7: Maintenance Requirements Definition

Equipment Class:		Breaker																															
Equipment Sub Class:		SF6																															
Equipment Sub Class Family:		ABC																															
Trigger Modifiers		**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**
	Functional Importance	Critical																									X	X	X	X	X	X	X	X	1M One monthly
		Significant																	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
		Run to fail	X	X	X	X	X	X	X	X																									2Y Once every two years
	Usage / Duty Cycle	High			X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X	3Y Once every three years
		Low	X	X			X	X			X	X			X	X			X	X			X	X			X	X			X	X			4Y Once every four years
	Environment	Harsh		X		X		X		X		X		X		X		X		X		X		X		X		X		X		X			
		Mild	X		X		X		X		X		X		X		X		X		X		X		X		X		X		X				
	Health	Very Good / Good	X	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					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					