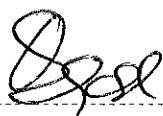
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Title: **Specification for 11 kV to 33 kV Fixed Pattern Metal-Enclosed Indoor Primary Switchgear Standard** Unique Identifier: **240-56062704**
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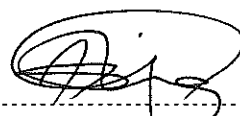
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Date: **20/4/17**

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	
2	A mature and stable technical area/technology	X
3	Established and accepted practices.	

PCM Reference: <xxxxxxx>

SCOT Study Committee Number/Name: <Number or name>

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1 INTRODUCTION

Due to relatively high land and building costs, limited space, the market prevalence of sealed-for-life primary switchgear technologies having extended electrical and mechanical endurance, as well as the key business objective of providing lower total cost of ownership technology solutions, it was decided to introduce compact medium voltage fixed-pattern metal-enclosed switchgear as an alternative to conventional medium voltage air-insulated withdrawable pattern switchgear.

Typical applications for compact fixed-pattern switchgear are primary distribution systems, emergency standby switchboards for traditional air-insulated indoor switchgear and as an alternative to the conventional air-insulated withdrawable pattern ('metal-clad') indoor switchboards where limited space is available.

The Distribution Division's specific requirements for indoor metal-enclosed primary switchgear of the fixed-pattern in accordance with SANS 62271-200 are set out in this specification. Specific requirements are given for the switchgear ratings, design and construction. In addition, requirements for testing, transport and installation, maintenance information, switchgear manuals and training are provided. When compiling a specification for a particular project, only those items applicable to that project need be included in the project schedules.

2 SUPPORTING CLAUSES

2.1 SCOPE

2.1.1 Purpose

This specification provides the Distribution Division's specific and standardised requirements for the purchasing of indoor metal-enclosed primary switchgear of the fixed-pattern design in accordance with SANS 62271-200. The switchgear is intended for use in Distribution substations, switching stations and mobile equipment having nominal operating voltages from 11 kV to 33 kV. A set of technical schedules A and B accompanies this specification. Schedule A gives the relevant clause number of this specification unless otherwise indicated. Additional and special requirements may also be included in schedule A.

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

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 NORMATIVE/INFORMATIVE REFERENCES

2.2.1 Normative

Parties using this specification shall apply the most recent edition of the documents listed below. Suppliers are responsible for obtaining copies of all National Rationalised Standards (NRS), South African National Standards (SANS) and international standards referred to in this specification. Copies of the latest revision of Eskom documents will be supplied by the purchaser and will form part of the enquiry documentation:

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

- [1] IEC 60071-1, Insulation co-ordination – Part 1: Definitions, principles and rules.
- [2] IEC 60073, Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators.
- [3] IEC 60112, Method for the determination of the proof and the comparative tracking indices of solid insulating materials.
- [4] IEC 60297-1, Dimensions of mechanical structures of the 482,6 mm (19 inch) series – Part 1: Panels and racks.
- [5] IEC 60376, Specification of technical grade sulphur hexafluoride (SF6) for use in electrical equipment.

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- [6] IEC 60447, Basic and safety principles for man-machine interface, marking and identification – Actuating principles.
- [7] IEC 60587, Electrical insulating materials used under severe ambient conditions – Test methods for evaluating resistance to tracking and erosion.
- [8] SANS 60044-1, Current Transformers.
- [9] SANS 60044-2, Voltage Transformers.
- [10] SANS 60270, Partial discharge measurements.
- [11] SANS 60529, Degrees of protection provided by enclosures (IP code).
- [12] SANS 60815-1:2009, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles.
- [13] SANS 61243-5, Live working – Voltage detectors – Part 5: Voltage detecting systems (VDS).
- [14] SANS 62271-1, High-voltage switchgear and control gear - Part 1: Common specifications.
- [15] SANS 62271-100, High-voltage switchgear and control gear - Part 100: High voltage alternating-current circuit-breakers.
- [16] SANS 62271-102, High-voltage switchgear and control gear - Part 102: High-voltage alternating current disconnectors and earthing switches.
- [17] SANS 62271-200, High-voltage switchgear and control gear - Part 200: AC metal-enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.

South African national standards

- [18] SANS 1019, Standard voltages, currents and insulation levels for electricity supply.
- [19] SANS 1091, National colour standards for paint.
- [20] SANS 4521, Metallic coatings – Electrodeposited silver and silver alloy coatings for engineering purposes.
- [21] SANS 10198-13, The selection, handling and installation of electric power cables of rating not exceeding 33 kV – Part 13: On-site testing and fault location.

South African NRS standards:

- [22] NRS 012 (SANS 876), Cable terminations and live conductors within air-insulated enclosures (insulation co-ordination) for rated a.c. voltages of 7,2 kV and up to and including 36 kV.
- [23] NRS 087, Guidelines for the management of SF6 (sulphur hexafluoride) for use in electrical equipment.

Eskom standards

- [24] DGL 34-933, Distribution Standard Part 15: Distribution guide for the application of busbar blocking protection.
- [25] DSP 34-253, Distribution Standard Part 15: Distribution specification for electrical terminal blocks.
- [26] 240-56030659, Station Class, Metal-Oxide Surge Arresters Without Spark-Gaps Standard.
- [27] 240-56062515, Labels on Control Panels, Relay Panels and Other Indoor and Outdoor Equipment Standard.
- [28] DSP 34-1515, Distribution Standard Part 15: Specification for a protection scheme for metal-enclosed indoor primary switchgear.
- [29] 240-56030619, Distribution Standard Part 22: Accessories for Medium-Voltage Power Cables for Systems with Nominal Voltages of 11 kV to 33 kV Standard.
- [30] DSP 34-1658, Distribution Standard Part 4: Corrosion protection specification for new indoor and outdoor Distribution equipment manufactured from steel.
- [31] 240-56065202, Switchgear Training Requirements from Original Equipment Manufacturers Standard.
- [32] 240-56063710, MV Cabling in Substations Standard.

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- [33] DST 34-1439 , Distribution Standard Part 12: Standard for the labelling of high voltage equipment.
- [34] 240-56063705 Requirements for the Wiring of Indoor Switchgear from 11 kV up to and Including 33 kV Standard
- [35] ESP 32-642, Eskom quality management – supplier requirements.
- [36] 240-56063765, Eskom Health and Safety Management Supplier Requirement Standard

Eskom drawings:

- [37] D-DT-5049, Control and relay panel engraving and labelling requirements.
- [38] D-DT-5408, Wiring of indoor switchgear.
- [39] D-DT-5238, National standard combo control building detail plans (various types), sections & elevations.
- [40] D-DT-8019, Clamp, cable polypropylene.

2.2.2 Informative

None

2.3 DEFINITIONS

The definitions and abbreviations given in SANS 62271-200 and the following shall apply:

Definition	Description
1U	A unit of vertical measurement as per IEC 60297-1 equivalent to 44,45 mm.
breakdown maintenance	Unplanned (or unscheduled) maintenance work required to repair a fault and thus restore the switchgear and controlgear to an acceptable condition after a failure.
EARTH position	state of a functional unit of fixed-pattern switchgear in which the main circuit of the functional unit is short-circuited and earthed.
IAC AFLR	Internal arc classification for type A (operator safety) accessibility for the front side, lateral side and rear side of the panel
local (on-board) control gear	general term covering control gear (e.g. relays, control switches, etc.) located in the LV compartment of the switchgear panel.
LSC 2	functional unit having at least an accessible compartment for the high-voltage connection (called connection compartment), such that, when this compartment is open, at least one busbar can remain energized and all other functional units of the switchgear and controlgear can be operated normally
major maintenance (overhaul)	<p>Work performed with the objective of repairing or replacing parts which are found to be out of tolerance by inspection, test, examination, or as required by manufacturer's maintenance manual, in order to restore the component and/or the switchgear and controlgear to an acceptable condition (within tolerance).</p> <p>NOTES</p> <p>This is the definition of "overhaul" given in 3.1.11 of SANS 62271-1.</p> <p>Major maintenance involves the execution of specialised maintenance where specialised knowledge and skills are required and is also sometimes referred to as specialised maintenance.</p>

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Definition	Description
minor maintenance	<p>The execution of scheduled or preventive maintenance work in accordance with the manufacturer's maintenance manual and requiring the switchgear and controlgear to be taken out of service (i.e. in a down state).</p> <p>NOTES</p> <p>a. Observations resulting from minor maintenance can lead to the decision to carry out an overhaul.</p> <p>Scheduled maintenance is defined in 3.1.7 of SANS 62271-1.</p> <p>Minor maintenance may be time-based and/or condition-based.</p> <p>Minor maintenance may also include circuit-breaker examination (refer to 3.1.10 of SANS 62271-1) with diagnostic tests (refer to 3.1.9 of SANS 62271-1).</p> <p>Minor maintenance may also be referred to as 2nd line maintenance.</p>
OFF position	<p>State of a functional unit of fixed-pattern switchgear in which the main circuit of the functional unit is disconnected (isolated) from the assembly busbar.</p> <p>NOTE: For example, in a functional unit incorporating a circuit-breaker and disconnector, the OFF position would require both the circuit-breaker and disconnector to be in their respective open positions.</p>
ON position	<p>State of a fixed-pattern functional unit in which a main circuit of the functional unit is connected to the busbar.</p> <p>NOTE: In a functional unit incorporating a circuit-breaker and disconnector, the ON position would require both the circuit-breaker and disconnector to be in their respective closed positions.</p>
Panel	<p>General term referring to a functional unit of metal-enclosed switchgear in accordance with SANS 62271-200. Refer to 3.2.3 for a description of the types of panels covered by this specification.</p>
remote (off-board) control gear	<p>General term covering control gear (e.g. protection relays, control switches, etc.) located in a separate swing frame panel and located in a separate room (control room) to the switchgear switchroom.</p>
routine inspection	<p>Visual investigation of the principal features of the switchgear and controlgear in service without dismantling.</p> <p>NOTES</p> <p>a. This inspection is generally directed toward pressures and/or levels of fluids, tightness, position of relays, pollution of insulating parts, but actions such as lubricating, cleaning, washing, etc. which can be carried out with the switchgear and controlgear in service are also included.</p> <p>b. Observations resulting from inspection can lead to the decision to carry out an overhaul.</p> <p>c. As indicated in note 1 above, routine inspection may include scheduled maintenance activities in accordance with the manufacturer's maintenance manual.</p> <p>d. Routine inspection may also be referred to as 1st line maintenance.</p> <p>e. This is the definition of "inspection" given in 3.1.8 of SANS 62271-1.</p>
specialised tools	<p>Any purpose-built tools that are necessary to carry out major (or specialised) maintenance on a circuit-breaker and its components.</p>
stand-off remote control unit	<p>(also referred to as the umbilical cord or pendant control) A removable device connected to the LV compartment of a switchgear panel (by means of a ± 20 m lead). This device is used by an operator for remote tripping/closing of</p>

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Definition	Description
	circuit-breakers.
Switchboard	A complete switchgear assembly consisting of number of switchgear panels (switchgear panels include incomer panels, feeder panels, bus-section panels, VT panels, etc.)

2.3.1 Disclosure Classification

Controlled Disclosure: Controlled Disclosure to External Parties (either enforced by law, or discretionary).

2.4 ABBREVIATIONS

Abbreviation	Description
ARC	Auto re-closing (i.e. an O-CO operation under command of a relay)
CT	Current transformer
DN8	8 mm SF ₆ 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.
IAC	Internal arc classification
LSC	Loss of service continuity
OEM	Original equipment manufacturer
SCD	Specific creepage distance
USCD	Unified specific creepage distance
VT	Voltage transformer

2.5 ROLES AND RESPONSIBILITIES

None

2.6 PROCESS FOR MONITORING

None

2.7 RELATED/SUPPORTING DOCUMENTS

None

3 SPECIFICATION FOR 11KV TO 33KV FIXED PATTERN METAL-ENCLOSED INDOOR PRIMARY SWITCHGEAR

This document is the specification for 11 kV to 33 kV fixed pattern metal enclosed indoor primary switchgear.

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For ease of reference, the clause numbering used in section 4, 5 and 6 in this document corresponds to that of SANS 62271-200 and SANS 62271-100.

4 RATINGS

4.1 RATED VOLTAGE (U_R) AND NUMBER OF PHASES

4.1.1 The rated voltage of the switchgear shall be in accordance with the values given in Table 1. The rated voltage required will be specified in schedule A. The rated voltage offered shall be stated in schedule B.

NOTE The nominal system voltages in Eskom Distribution are 11 kV, 22 kV and 33 kV.

4.1.2 The number of phases shall be three.

4.2 RATED INSULATION LEVEL

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

Table 1 – Rated voltage and insulation levels¹⁾

Nominal system voltage U_n [kV (r.m.s.)]	Rated voltage U_r [kV (r.m.s.)]	Rated short-duration power-frequency withstand voltage U_d [kV (r.m.s.)]		Rated peak lightning impulse withstand voltage U_p [kV (peak)]	
		Common value	Across isolating distance	Common value	Across isolating distance
11	12	28	32	95	110
22	24	50	60	125 ²⁾	145
33	36	70	80	170 ²⁾	195

NOTES

- The information in this table is extracted from SANS 62271-1 and SANS 1019.
- For 24 kV and 36 kV rated switchgear, the lightning impulse withstand voltage insulation level specified in this table is limited to the maximum insulation levels commercially available and is in accordance with the highest insulation levels offered in accordance with SANS 62271-1. These levels correspond to "List 2" insulation levels in accordance with SANS 1019. Special attention is paid to the application of surge protection devices (i.e. surge arresters) when connecting 24 kV and 36 kV rated switchgear to overhead lines.
- In this table, the withstand voltage applies at the standardised reference atmosphere (temperature, pressure and humidity) in accordance with IEC 60071-1.
- Due to the fact that fixed-pattern switchgear is gas-insulated and/or fully screened solid-dielectric insulated with no external insulation, no altitude correction in accordance with SANS 62271-1 is required.

4.3 RATED FREQUENCY (F_R)

The rated frequency shall be 50 Hz.

4.4 RATED NORMAL CURRENT (I_R) AND TEMPERATURE RISE

4.4.1 For 11 kV switchgear, the rated normal current of the busbar, bus-section and incomer panel main circuits shall be 1250 A or 2500 A. The rated normal current of the busbar required will be specified in schedule A. The rated normal current of the busbar offered shall be stated in schedule B.

4.4.2 For 22 kV switchgear, the rated normal current of the busbar, bus-section and incomer panel main circuits shall be 1250 A. The rated normal current of the busbar offered shall be stated in schedule B.

4.4.3 For 33 kV switchgear, the rated normal current of the busbar, bus-section and incomer panel main circuits shall be 1250 or 2000 A. The rated normal current of the busbar offered shall be stated in schedule B.

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4.4.4 The rated normal current of all feeder panel main circuits shall be 630 A or 1250 A. The rated normal current of the feeder panel required will be specified in schedule A. The rated normal current of the feeder panel offered shall be stated in schedule B.

4.4.5 The standard rated normal currents of the panel main circuits are given in Table 2.

Table 2 – Rated normal currents (I_r)

Nominal system voltage U_n [kV]	1250 A Busbar rating			2000 A Busbar rating			2500 A Busbar rating		
	Panel application			Panel application			Panel application		
	Incomer	Bus-section	Feeder	Incomer	Bus-section	Feeder	Incomer	Bus-section	Feeder
	I_r [A]	I_r [A]	I_r [A]	I_r [A]	I_r [A]	I_r [A]	I_r [A]	I_r [A]	I_r [A]
	1250	1250	630/1250	2000	2000	630/1250	2500	2500	630/1250
11	x	x	x	-	-	-	x	x	x
22	x	x	x	-	-	-	-	-	-
33	x	x	x	x	x	x	-	-	-

4.4.6 The associated temperature rise for the normal currents given in Table 2 shall be in accordance with SANS 62271-200.

4.4.7 All normal current ratings and associated temperature rises shall be based on natural air cooling. Forced air cooling will not be accepted.

4.5 RATED SHORT-TIME WITHSTAND CURRENT (I_k AND I_{KE})

4.5.1 The rated short-time withstand current (I_k) of the main circuit (i.e. including busbars, circuit-breakers and disconnectors) and earthing switches shall be in accordance with the values given in Table 3. The rated short-time withstand current offered shall be stated in schedule B.

4.5.2 The rated short-time withstand current (I_{KE}) of the earthing circuit of switchgear (i.e. earthing bars of the earthing system) shall be in accordance with the values given in Table 3. The rated short-time withstand current offered shall be stated in schedule B.

4.6 RATED PEAK WITHSTAND CURRENT (I_p AND I_{pE})

4.6.1 The rated peak withstand current (I_p) of the main circuit (i.e. including busbars, circuit-breakers and disconnectors) and earthing switches shall be in accordance with the values given in Table 3. The rated peak withstand current offered shall be stated in schedule B.

4.6.2 The rated peak withstand current (I_{pE}) of the earthing circuit of switchgear (i.e. earthing bars of the earthing system) shall be in accordance with the values given in Table 3. The rated peak withstand current offered shall be stated in schedule B.

NOTE A standard system time d.c. constant of 45 ms has been used.

4.7 RATED DURATION OF SHORT CIRCUIT (T_k AND T_{KE})

4.7.1 The rated duration of the short circuit (t_k) or the main circuit (i.e. including busbars, circuit-breakers and disconnectors) and earthing switches shall be 3 seconds.

4.7.2 The rated duration of the short circuit (t_{KE}) or the earthing circuit (i.e. earthing bars of the earthing system) shall be 1 second.

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Table 3 – Rated short-circuit breaking, short-time and peak withstand currents

Nominal system voltage U_n [kV]	Rated short circuit-breaking and short-time (3 sec) withstand current I_{SC}, I_k, I_{ke} [kA (r.m.s.)]	Rated peak withstand current I_p, I_{pe} [kA (peak)]
11	31.5	78.75
11	25	62.5
22	31.5	78.75
22	25	62.5
33	31,5	78.75

4.8 RATED SUPPLY VOLTAGE OF CLOSING AND OPENING DEVICES AND OF AUXILIARY AND CONTROL CIRCUITS (U_A)

4.8.1 The rated d.c. supply voltage (U_a) of closing and opening devices, motorised disconnectors and of auxiliary and control circuits shall be 110 V.

4.8.2 The rated a.c. supply voltage (U_a) of a.c. auxiliary circuits shall be single-phase 230 V.

4.9 RATED SUPPLY FREQUENCY OF CLOSING AND OPENING DEVICES AND OF AUXILIARY CIRCUITS

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

4.101 RATED SHORT-CIRCUIT BREAKING CURRENT (I_{SC}) OF CIRCUIT-BREAKERS

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 Table 3. The rated short-circuit breaking current shall be stated in schedule B.

4.102 TRANSIENT RECOVERY VOLTAGE RELATED TO THE RATED SHORT-CIRCUIT BREAKING CURRENT OF CIRCUIT-BREAKERS

4.102.1 The first-pole-to-clear factor (k_{pp}) for circuit-breakers shall be 1,5 in accordance with SANS 62271-100, i.e. as applicable to circuit-breakers used in non-effectively earthed systems. The first-pole-to-clear factor shall be stated in schedule B.

4.102.2 The standard values of prospective transient recovery voltages given in SANS 62271-100 shall apply according to the circuit-breaker class specified in Table 4 for the relevant circuit-breaker application and as defined in SANS 62271-100.

4.103 RATED SHORT-CIRCUIT MAKING CURRENT OF CIRCUIT-BREAKERS AND EARTHING SWITCHES

The rated short-circuit making current of circuit-breakers and earthing switches shall be equal in value to the rated peak withstand current specified in Table 3. The rated short-circuit making current shall be stated in schedule B.

4.104 RATED OPERATING SEQUENCE FOR CIRCUIT-BREAKERS

4.104.1 The following rated operating sequence shall apply to all feeder panel circuit-breakers, as is applicable for circuit-breakers intended for rapid 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.

4.104.2 The following rated operating sequence shall apply to all incomer and bus-section circuit-breakers, as is applicable for circuit-breakers not intended for rapid auto-reclosing:

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

4.104.3 The rated operating sequence 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.

4.104.4 All feeder panel circuit circuit-breakers shall be able to open-close-open before the closing spring needs to be charged again.

NOTE In the case of electromagnetic actuator mechanisms, energy storage to achieve this requirement is provided through the use of capacitors (as an alternative to the use of springs).

4.105 CHARACTERISTICS FOR SHORT-LINE FAULTS

These characteristics are applicable to class S2 circuit-breakers intended for direct connection to overhead lines in systems with a solidly earthed neutral and are therefore not applicable to indoor switchgear.

4.106 RATED OUT-OF-PHASE MAKING AND BREAKING CURRENT FOR CIRCUIT-BREAKERS

The rated out-of-phase making and breaking currents assigned to the circuit-breaker offered shall be stated in schedule B.

4.107 RATED CAPACITIVE SWITCHING CURRENTS FOR CIRCUIT-BREAKERS

4.107.1 The classification of circuit-breakers according to their restrike performance for line-charging and cable-charging current switching shall be in accordance with Table 4 for the specified circuit-breaker application. The circuit-breaker class offered for line-charging and cable-charging current switching shall be stated in schedule B.

4.107.2 The rated line-charging and cable-charging breaking currents for circuit-breakers shall be in accordance with the preferred values given in SANS 62271-100.

4.108 INDUCTIVE LOAD SWITCHING FOR CIRCUIT-BREAKERS

No rating is assigned.

4.109 RATED TIME QUANTITIES FOR CIRCUIT-BREAKERS

Refer to SANS 62271-100. The rated opening time, break-time, closing time, open-close time, reclosing time and close-open time shall be stated in schedule B.

4.110 NUMBER OF MECHANICAL OPERATIONS FOR CIRCUIT-BREAKERS AND DISCONNECTORS

The number of mechanical operations of circuit-breakers and disconnectors shall be in accordance with the mechanical endurance class specified in Table 4 for the specified circuit-breaker application and as defined in SANS 62271-100 and SANS62271-102 respectively. The circuit-breaker class offered shall be stated in schedule B.

4.111 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 Table 4 for the specified circuit-breaker application. The circuit-breaker class offered shall be stated in schedule B.

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Table 4 – Classification of switchgear (SANS 62271-100 and SANS 62271-102)

Circuit-breaker application ³⁾	Circuit-breaker class		Circuit-breaker electrical endurance	Circuit-breaker re-strike performance during capacitive current breaking (line-charging and cable-charging)	Circuit-breaker mechanical endurance	Disconnecter mechanical endurance
	Rated voltage					
	12 kV	24 kV and 36 kV				
Incomer	S1 ⁴⁾	S2 ⁵⁾	E2 ¹⁾	C1	M1	M1
Bus-section	S1 ⁴⁾	S2 ⁵⁾	E2 ¹⁾	C1	M1	M1
Feeder	S1 ⁴⁾	S2 ⁵⁾	E2 ²⁾	C2	M2	M1
NOTES						
1. Class E2: Extended electrical endurance without auto-reclosing duty capability.						
2. Class E2: Extended electrical endurance intended for auto-reclosing duty for overhead line feeder application.						
3. Refer to 5.3 for a description of the types of panels (functional units) covered by this specification.						
4. Class S2 circuit-breakers (i.e. circuit-breakers intended to be used in line-systems) are restricted to systems of rated voltages equal to or higher than 15 kV and less than 100 kV – in accordance with SANS 62271-100. Circuit-breakers for use at 11 kV are therefore classified as class S1 circuit-breakers.						
5. Class S2 circuit-breakers are specified for circuit-breakers of rated voltages of 24 kV and 36 kV due to the fact that they may be used in systems where there is only a short length of cable between the circuit-breaker and the overhead line or between the circuit-breaker and the supply transformer.						

5 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. If the supplier decides to make any changes to the agreed-upon design of the switchgear, 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 8.4).

5.1 SERVICE CONDITIONS

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

- a) a minimum ambient air temperature of -5 °C;

NOTE A maximum ambient air temperature of 40 °C is applicable, in accordance with the 'normal' service conditions for indoor switchgear as specified in SANS 62271-1.

- b) the switchgear shall be installed up to altitudes of 1 800 m;

NOTE No altitude correction factors are required for fixed pattern switchgear in accordance with this specification as no external insulation is permitted.

- c) dust, smoke, corrosive gases, vapours or salt may pollute the ambient air. Due to the switchgear being installed in a switch room, the class of pollution characterising the site severity shall be "C" (i.e. "medium") in accordance with SANS 60815-1:2009; and

5.1.2 Circuit-breakers shall be suitable for operation in systems that incorporate a non-effectively earthed neutral.

5.2 GENERAL

5.2.1 Indoor metal-enclosed switchgear shall comply with the requirements of SANS 62271-200 and the requirements of this specification. Where conflicting requirements exist, the requirements of this specification shall take precedence.

5.2.2 The switchgear shall be of the fixed pattern design.

5.2.3 The switchgear shall be sealed for life with a minimum maintenance-free period of 30 years for all high-voltage parts. In the case of gas-filled compartments, this implies sealed pressure systems where the period to

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replenishment of the insulating medium shall not be less than 30 years. The insulating medium and maintenance-free period shall be stated in schedule B.

NOTE Sealed for life switchgear, which utilises, for example, gas-filled (e.g. dry air, SF₆, etc.) sealed pressure system compartments and/or fully screened solid dielectric insulation technology, does not have any exposed or external insulation in ambient air and thus the performance thereof is not affected by the environment (ambient pollution, altitude, humidity, condensation, etc.).

5.2.4 The switchgear shall be designed to provide maximum service continuity and reliability. Details regarding the procedure for the on-site replacement of a damaged/faulted panel in a switchboard, including the necessary in-situ gas-work (where applicable), shall be provided with the tender documentation (refer to 5.24.1).

5.2.5 Circuit-breakers shall comply with the requirements of SANS 62271-100 and the requirements of this specification. Where conflicting requirements exist, the requirements of this specification shall take precedence.

5.2.6 Circuit-breakers shall be three-pole operated and 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 mechanism spring both manually and electrically. Electrical charging shall be via a spring charging motor. Both manual and electric energy release shall be provided. A mechanical device shall be provided to prevent over-charging of the closing spring when the manual charging facility is employed.

NOTES

1. Hydraulic, pneumatic or hydraulic spring operated mechanisms will not be accepted.
2. An electromagnetic actuator mechanism with a suitable stored energy device (e.g. capacitor) to provide the electrical energy required for the specified operating sequence (i.e. open-close-open – refer to 4.104.4) may be accepted.

5.2.7 Circuit-breaker operating mechanisms shall be designed in such a way that in the case of failure to latch or of a command to trip during a closing operation, safe conditions are produced for the elements controlling the circuit-breaker.

5.2.8 Circuit-breakers shall be provided with a mechanical TRIP and CLOSE control facility. Only the TRIP control facility shall be available on the front of the circuit-breaker panel.

5.2.9 The interrupting medium of circuit-breakers shall be vacuum. The type of interrupting technology offered shall be stated in schedule B.

5.2.10 Circuit-breaker mechanisms shall be designed as maintenance free in accordance with the electrical and mechanical endurance class as specified in Table 4. They shall be accessible for inspection and maintenance without the need for opening the gas system (where applicable).

5.2.11 Disconnectors shall comply with the requirements of SANS 62271-102 and the requirements of this specification. The type of disconnector offered (e.g. three-position disconnector) shall be stated in schedule B.

5.2.12 In the case of gas-insulated switchgear, details of the effect of reduced internal gas-pressure on the operation, safety and insulation levels of the switchgear (down to atmospheric pressure) shall be provided with the tender documentation (refer to 5.24.1).

5.3 ARCHITECTURE AND ACCESSIBILITY TO COMPARTMENTS

5.3.1 The switchgear shall be of the single busbar design and shall include, where applicable, the following defined panel types (functional units):

5.3.1.1 “*incomer*” panels incorporating a three-pole operated circuit-breaker, disconnector, cable earthing device and cable compartment fitted with CTs;

5.3.1.2 “*feeder*” panels incorporating a three-pole operated circuit-breaker, disconnector, cable earthing device and cable compartment fitted with CTs;

5.3.1.3 “*bus-section*” panels incorporating a three-pole operated circuit-breaker, disconnectors, CT and, where applicable, busbar earthing devices; and

NOTE In general, for incomer, feeder and bus-section panels, the following two options are considered for earthing devices (refer to 5.7.2):

- a) earthing via the circuit-breaker in combination with a disconnector; or
- b) earthing via a separate integral earthing switch.

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5.3.2 Incomer and feeder panels shall have the following minimum defined compartments:

5.3.2.1 “*circuit-breaker*” compartment housing the three-pole operated circuit-breaker;

5.3.2.2 “*busbar / disconnecter*” compartment;

NOTE The provision of a separate circuit-breaker compartment to the busbar/disconnector compartment maximises the availability of the distribution network in the event of a fault/failure affecting the integrity of the circuit-breaker compartment.

5.3.2.3 “*cable*” compartment for housing the power cable terminations and, where applicable, CTs; and

5.3.2.4 “*LV*” compartment with front access for housing the auxiliary and control circuit terminal strips and equipment.

5.3.3 Bus-section panels shall have the following minimum defined compartments:

5.3.3.1 “*circuit-breaker*” compartment housing the three-pole operated circuit-breaker;

5.3.3.2 “*busbar / disconnecter*” compartments, each of which may incorporate the relevant bus-section disconnecter; and

5.3.3.3 “*LV*” compartment with front access for housing the auxiliary and control circuit terminal strips and equipment.

5.3.4 Accessibility to each compartment, in accordance with SANS 62271-200, shall be as follows:

5.3.4.1 in the case of gas-filled compartments, the circuit-breaker and busbar / disconnecter compartments: non-accessible compartment;

NOTE The provision of repair-openings in non-accessible compartments providing increased switchgear availability / service continuity in the event of a failure will be subject to approval by Eskom. Switchgear offering repair-openings may be given preference.

5.3.4.2 in the case of non-gas-filled compartments (e.g. busbar compartment housing fully screened solid dielectric insulated busbars): tool-based accessible compartment; and

5.3.4.3 cable compartments: interlock-controlled accessible compartment.

5.4 SERVICE CONTINUITY OF THE SWITCHGEAR

The loss of service continuity category shall be “LSC2” in accordance with SANS 62271-200.

NOTE Loss of service continuity is only applicable to accessible compartments. In the case of gas-insulated switchgear, it is therefore only applicable to the cable compartment.

5.5 PARTITION CLASS

The partitioning class shall be “PM” (i.e. metallic partitions and/or shutters) in accordance with SANS 62271-200.

5.6 INTERNAL ARC CLASSIFICATION

5.6.1 The internal arc classification (IAC) for the indoor switchgear shall be AFLR in accordance with SANS 62271-200.

5.6.2 The classification test current value shall be in accordance with the rated short-time withstand current specified in Table 3 with a duration of 1 second.

5.6.3 The switchgear shall be designed in such a manner that pressure relief is upwards and directed away from the operator.

5.6.4 It shall not be necessary to require access to the top of the switchgear (i.e. where internal arc pressure relief flaps are located) for normal operation and maintenance activities.

5.6.5 Where internal arc absorbers / coolers are offered, this shall be stated in schedule B and details shall be provided with the tender documentation (refer to 5.24.1). Preference will be given to switchgear offering integrated arc absorbers / coolers. Any ducting system for internal arc pressure relief / absorption shall be a type tested design.

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5.6.6 Where additional ducting is required in order to achieve the specified internal arc classification, this shall be stated in schedule B and details shall be provided with the tender documentation (refer to 5.24.1).

NOTE Ducting is not required to exhaust the internal arc by-products outside the switchroom.

5.7 EARTHING CIRCUIT AND EARTHING DEVICES

5.7.1 Earthing circuit

5.7.1.1 The earthing circuit of the switchboard shall comprise of copper earthing bars.

5.7.1.2 For the 25 kA rated switchgear minimum earthing bar cross section shall be 25 x 5 mm – providing a minimum cross section area of 125 mm². The cross section dimensions of the earthing bars offered shall be stated in schedule B.

5.7.1.3 For the 31.5 kA rated switchgear, the minimum earthing bar cross section shall be providing a minimum cross section area of 157.5 mm². The cross section dimensions of the earthing bars offered shall be stated in schedule B.

5.7.1.4 The accessible switchgear earthing bars shall be provided with suitable facilities for the termination of earthing conductors having an M12 fixing hole. Each fixing hole shall be fitted with a stainless steel or brass M12 set screw, washer, spring washer and nut.

5.7.2 Earthing devices and interlocks

5.7.2.1 For each incomer and feeder panel, cable earthing shall be provided via the circuit-breaker in combination with the disconnecter. Alternatively, each incomer and feeder panel shall be fitted with an integral cable earthing switch of minimum class E1 in accordance with SANS 62271-102. In the latter case, a cable earth mechanical interlocking system shall be provided to ensure that operation of the cable earthing switch is prevented unless the associated disconnecter is only in the open (disconnected) position. The interlocking device shall prevent the disconnecter from being closed when the associated cable earthing switch is closed.

NOTE The above requirement ensures that simultaneous busbar connection and earthing is prevented.

5.7.2.2 Earthing of the busbar shall be by means of the bus-section circuit-breaker in combination with the disconnecter. Alternatively, an integral busbar earthing switch of minimum class E1 in accordance with IEC 62271-102 shall be provided. In the case where a bus-section panel is not required, the busbar shall be temporarily earthed either through the cable test facility or a separate busbar earth panel. Details of the specific busbar earthing arrangement shall be specified in Schedule B. The panel used for busbar earthing shall be stated in schedule B.

5.7.2.3 In the case where earthing switches in accordance with SANS 62271-102 are provided, they shall be of the independent manual operation type (i.e. independent unlatched operation where the origin of the energy is manual).

5.7.2.4 Where a circuit-breaker is used for earthing, the electrical tripping circuit of the circuit-breaker shall be disconnected when in the earthing (EARTH) position.

5.7.2.5 The cable earthing interlocking system shall use a contact from the cable live indication system to prevent the cable earth being applied to a live cable. 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.

5.7.2.6 A busbar earth interlocking system shall be provided to ensure that operation (i.e. closing) of the busbar earthing switch or closing of the busbar earthing circuit-breaker shall be prevented unless all disconnectors (of the relevant bus-section to be earthed) are only in the open (disconnected) or earthed positions. The busbar earthing interlocking shall use a contact from the busbar live indication system as an additional measure to prevent earthing of a live busbar. The interlocking system shall eliminate the possibility of closing any of the disconnectors while the busbar earth is applied. 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.

5.7.2.7 The general procedure for earthing the busbar shall be as follows:

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- a) open all bus-section circuit-breakers and their associated disconnectors connected to the busbar section to be earthed.
- b) open all incomer and feeder circuit-breakers and their associated disconnectors on the switchgear panels connected to the busbar section to be earthed.
- c) earth the busbar section by either:
 - switching the disconnector (on the opposite side of the bus-section circuit-breaker to the bus-section being earthed) to the earthing position and closing the bus-section circuit-breaker in the bus-section panel associated with that section; or
 - closing the busbar earthing switch in the busbar earthing panel associated with that section.

NOTE Where a circuit-breaker is used for busbar earthing, the closing operation will be via the stand-off remote control unit as the mechanical CLOSE button for circuit-breakers on the compartment door is required to be disabled.

5.7.2.8 Positive mechanical interlocking shall be provided to prevent inadvertent switching from the ON position to the EARTH position without a definite stop in the OFF position, or from the EARTH position to the ON position without a definite stop in the OFF position.

5.8 PADLOCKING FACILITIES

5.8.1 Facilities shall be provided to padlock the following:

- a) the switchgear functional unit in the OFF, ON and EARTH positions;
- b) in the case where the circuit-breaker is used for earthing, the mechanical tripping device.

5.8.2 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.

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

5.9 STAND-OFF HAND-HELD REMOTE CONTROL UNIT FOR REMOTE SWITCHING OF CIRCUIT-BREAKERS

5.9.1 Each switchboard shall be supplied with a stand-off hand-held remote control unit (also referred to as an umbilical cord / pendant control) which shall be used for remote switching (i.e. trip/close) of all circuit-breakers.

5.9.2 The minimum length of the lead shall be 20 m. If a longer length is required, it will be specified in schedule A.

NOTE For larger substation switch rooms, a longer length may be required in order to ensure that all circuit-breakers can be switched from outside the switch room door.

5.9.3 The control box of the hand-held remote control unit shall be fitted with two control push-buttons as follows:

5.9.3.1 red push-button with the “I” symbol – for closing the circuit-breaker; and

5.9.3.2 green push-button with the “O” symbol – for tripping the circuit-breaker.

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

5.9.4 The control box of the hand-held remote control unit shall have a minimum degree of protection of IP67 in accordance with SANS 60529.

5.9.5 The stand-off remote control unit shall have a plug-in circular panel connector and matching female receptacle with a self-retaining bayonet type coupling in accordance with the make and type specified in schedule A. The wiring of the pins shall be as specified in schedule A.

5.9.6 The female receptacle for the plug-in connector shall be located on the front LV compartment door.

5.9.7 The female receptacle shall be wired directly to the terminals provided for in the LV compartment in accordance with 240-56063705 and D-DT-5408.

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5.9.8 Facilities for local closing of the circuit-breaker when the disconnecter is in the closed position shall be disabled to prevent an operator from closing the circuit-breaker while standing in front of the panel. It shall only be possible to close the circuit-breaker remotely or using the stand-off remote control unit.

5.10 MOTORISED DISCONNECTORS

5.10.1 Each switchgear panel disconnecter shall be motorised using an integral internal motor.

5.10.2 The auxiliary supply for the motorised racking device shall be 110 V d.c. The continuous power rating of the motor together with the total disconnecting time (i.e. time taken for the motor to operate the disconnecter) shall be stated in schedule B.

5.10.3 The motorised disconnecter shall comply with and be wired in accordance with 240-56063705 and D-DT-5408.

5.10.4 Manual operation of the disconnecter shall be possible in the event of an emergency.

5.10.5 The operation of the disconnecter shall only be possible when the circuit breaker is in the open position, a suitable interlocking mechanism shall be provided for this requirement.

5.11 SWITCHBOARD PHYSICAL DESIGN

5.11.1 Physical requirements

5.11.1.1 The configuration of the switchboard shall conform to the single-line schematic diagram included with the switchgear ordering schedule.

NOTE A model switchgear ordering schedule template is shown in Annex B.

5.11.1.2 The switchgear panels shall be suitable for installation over a cable trench and within a standard switch room in accordance with the requirements of D-DT-5238. Any special requirements or limitations for installation shall be stated by the supplier with the tender documentation (refer to 5.24.1).

NOTE The suppliers attention is drawn to the standard room height of 3,2 m, standard door dimensions, etc.

5.11.1.3 All switchgear panels shall be designed for operation from the front.

5.11.1.4 The switchboard shall be designed so that the fronts of the panels are fully aligned.

5.11.1.5 A customised steel support frame/base shall be provided to allow the switchgear panels to be supported over the entire width of the cable trench. The minimum height of the support frame/base shall be 75 mm.

5.11.1.6 Access to the cable trench shall be from the rear of the switchgear in the case of rear-entry cable compartments or from the front of the switchgear in the case of front-entry cable compartments. Access to the cable compartment for the termination of the cables shall not be adversely obstructed by the steel support frame/base. The cable trench entry area provided shall be at least 800 mm wide measured between the end of the switchgear panel and the side wall of the cable trench.

5.11.1.7 Removable, custom-fitted non-slip steel trench cover plates (e.g. chequer plates) of minimum thickness 4,5 mm shall be provided and fitted by the supplier to close off the accessible cable trench once the cables have been terminated. These trench cover plates shall be designed to fit securely onto the steel support frame/base. In the case of front-entry cable compartments, the steel support frame/base together with the trench cover plates shall form an operating platform having a minimum width of 1000 mm. The edge of the support frame/base shall be suitably marked with hazard identification so as to minimise the risk of personnel tripping. A drawing showing the design of the steel support frame/base shall be provided with the tender documentation (refer to 5.24.1).

5.11.1.8 Provision shall be made to bolt the steel support frame/base to the concrete floor. Flanges that are provided for the fitting of holding-down bolts shall be a minimum of 5 mm thick steel or, alternatively, shall be reinforced to prevent them from bending during handling, transportation and installation.

5.11.1.9 The switchboard shall be suitable for future extensions on both sides of the switchboard.

5.11.1.10 The following dimensions / distances shall be stated in schedule B:

- a) the switchgear panel width (i.e. left to right);
- b) the switchgear panel depth (i.e. front to rear);

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- c) the switchgear panel overall height (i.e. highest point to bottom);
- d) the horizontal distance from the rear of the panel to the center of the LV control cable gland plate provided in the LV compartment;
- e) the minimum distance (clearance) required above the switchgear to the switch room ceiling (d_c);
- f) the minimum distance (clearance) required to the rear switch room wall;
- g) the minimum cable trench width required; and
- h) the minimum cable trench over-hang required for cable terminations (in the case of rear-entry cable compartments).

5.11.1.11 All doors shall be equipped with travel stops, which shall retain the door in the open position.

5.11.1.12 Suitable lifting eyes shall be attached to each panel at the top of each panel. The lifting eyes shall be designed to provide for the lifting of the complete assembly. Lifting eyes with a minimum diameter of 30 mm shall be provided.

5.11.2 LV compartment

5.11.2.1 The LV compartment shall be located in the front of the panel and shall be accessible without leaving floor level. No special keys or tools shall be required to open the LV compartment door.

5.11.2.2 Two removable 3 mm thick brass or aluminium gland plates, each with a minimum usable area of 150 mm x 100 mm, shall be fitted at the top left and right hand sides of the LV compartment for the top entry and glanding of all control cables. The gland plate shall be secured by a minimum of six M8 bolts with nuts and washers. The following pre-punched gland holes in accordance with Figure 1 shall be provided in each gland plate and fitted with knock-outs or rubber grommets:

- 2 x Ø32 mm each having a Ø65 mm clearance for the gland lock nut
- 2 x Ø20 mm having a Ø40 mm clearance for the gland lock nut

NOTES

1. The Ø32 mm pre-punched gland holes are suitable for number 3 size mechanical cable glands as required for 12-core and 19-core 600/1000 V PVC/SWA/PVC control cabling.
2. The Ø20 mm pre-punched gland holes are suitable for number 0/1 size mechanical cable glands respectively – as and when required (located at the top right hand side of the LV compartment).
3. In the case of on-board protection and control schemes, only one gland plate is required.

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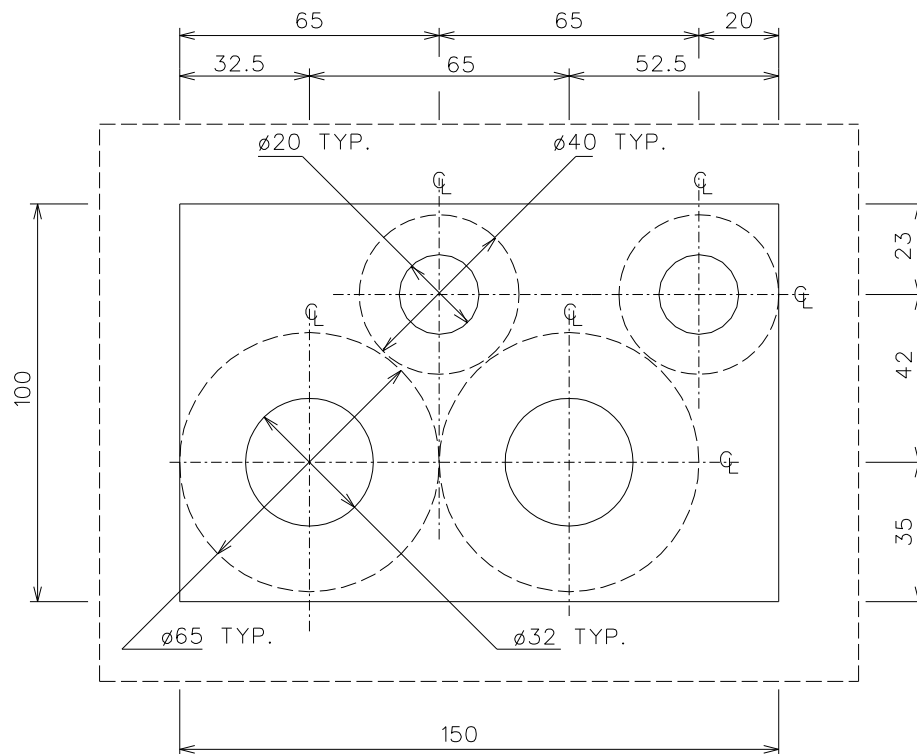


Figure 1 – LV control cable gland plate layout

5.11.2.3 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.

5.11.2.4 The LV compartment door shall include a cut out aperture for the mounting of on-board protection equipment by Eskom. The switchgear shall be delivered with the aperture closed by a removable 6U blanking plate. The cut out shall be a 19 inch rack in accordance with IEC 60297-1. The rack shall have minimum height of 266.7mm (6U). The depth of the LV compartment shall allow for an unobstructed clearance of 250 mm behind the door for the full height of the 19 inch rack, and for at least two thirds of the width. The 19 inch rack shall be punched with rectangular attachment holes and shall be recessed such that the blanking plate is flush mounted with the front of the door.

5.11.3 Degrees of protection of enclosures

5.11.3.1 The various parts of switchgear panel shall have the following minimum degrees of protection in accordance with SANS 60529:

- a) IP2X for moving parts;
- b) IP3X for live parts;
- c) IP3X for cable boxes; and
- d) IP65 for gas-filled compartments (where applicable).

5.11.3.2 The degrees of protection of the switchboard offered shall be stated in schedule B.

5.11.4 Busbars

5.11.4.1 In the event that a switchgear panel requires replacement, details regarding the procedure to be followed to remove and replace the panel shall be provided with the tender documentation (refer to 5.24.1).

5.11.4.2 In the case of solid dielectric insulated busbar systems, the complete busbar system, including all busbar connections shall be fully screened. Details of the busbar system offered shall be provided with the tender documentation (refer to 5.24.1).

5.11.4.3 The busbar connections between each panel shall be of the plug-in type.

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5.11.5 Corrosion protection of metal enclosures and busbars (where applicable)

5.11.5.1 All exposed sheet metal shall be protected against corrosion in accordance with DSP 34-1658 for indoor applications. The corrosion protection system (i.e. the detailed specification "DS" number) in accordance with DSP 34-1658 offered by the manufacturer shall be stated in schedule B.

5.11.5.2 All exposed joints and tees in earthing busbars and busbar connections that use bolts, nuts and washers shall be suitably protected against corrosion. Suitable methods of protection include phosphating, galvanizing, zinc impregnation and plating with copper, nickel, cadmium silver, tin or zinc. The details of the corrosion protection system applied shall be stated in schedule B.

5.11.5.3 All exposed nuts, bolts and washers shall be suitably protected against corrosion. The details of the corrosion protection system applied for all bolts, nuts and washers shall be stated in schedule B.

5.11.5.4 All exposed earthing bars shall be tinned or silverised unless otherwise accepted by Eskom.

5.12 INSULATION REQUIREMENTS

5.12.1 Bushings and insulators

5.12.1.1 Bushings for cable connections shall comply with the requirements for NRS 012.

5.12.1.2 All insulators and bushings shall be routine partial-discharge tested in accordance with SANS 60270.

5.12.2 Requirements for gas-filled compartments (where applicable)

5.12.2.1 All gas-filled compartments that do not require gas-filling on site shall be factory gas-filled and tested with new gas at the rated filling pressure.

NOTE Preference will be given to factory assembled, factory gas-filled and factory tested compartments.

5.12.2.2 No routine gas replenishment shall be required during normal service. This implies that the period to replenishment of the gas will be not less than 30 years. The maximum gas leakage rate per year for all 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.

5.12.2.3 SF₆ gas shall comply with the requirements of IEC 60376.

5.12.2.4 Where applicable, a certificate guaranteeing SF₆ purity to IEC 60376 shall be supplied with the switchgear. The following parameters shall be checked, recorded and a report submitted to Eskom after filling:

- SF₆ content – not less than 98%
- Dew-point at rated filling pressure – at least -30°C

5.12.2.5 The following requirements are applicable to gas-filled compartment filling and pressure monitoring:

5.12.2.5.1 When provided, a gas filling/evacuation point with a DILO DN8 connection shall be provided for each gas-filled compartment.

5.12.2.5.2 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.

5.12.2.5.3 A gauge responding to gas density and indicating gas pressure compensated for temperature shall be provided for each circuit-breaker/compartment and installed in such a position that it can be easily read when viewed from the front of the switchgear and from ground level. Alternative solutions, such as the use of gas pressure sensors/devices with discreet gas status indications (e.g. red and green), may be accepted and will be subject to approval by Eskom.

5.12.2.5.4 A gas density monitoring device (density switch), which may also be integrated into the dial type gauge as a dual function device, shall be provided. The density monitoring device switch shall provide the necessary contacts specified in 240-56063705 .

5.12.2.5.5 Electrical interlocks and alarms provided by the gas density monitoring device shall be in accordance with 240-56063705 .

5.12.2.5.6 Pressure gauges shall be numerically marked and calibrated in Pascal's (kPa or MPa). Only gauge pressure shall be indicated and rated pressure shall be no more than 80% of the full-scale reading. Gauge

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markings shall be clearly labelled 'Absolute' for gauges measuring absolute pressure or 'Atmospheric' for gauges measuring pressure exclusive of the atmosphere.

5.12.2.5.7 The density monitoring device shall give a positive and reliable response on reaching the operating values (no contact bounce).

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

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

5.12.2.5.9 Non-return valves shall be fitted on all DN8 fittings. The gas pressure shall be maintained in the system when the density monitoring device is removed or replaced. The supplier shall submit details of the arrangements offered together with the tender documentation (refer to 5.24.1).

5.12.2.5.10 Any exposed pipe work shall be made of stainless steel or copper and mounted in such a manner that it is mechanically protected.

5.12.2.5.11 Device actuation and de-actuation differentials shall be consistent over the ambient temperature range as specified in clause 5.1.

5.12.2.5.12 Complete details of all gas pressure devices, including drawings, manufacturer's specifications, performance and test data, details of production tests and a quality control programme, shall be included with the tender documentation (refer to 5.24.1).

5.12.2.6 Where applicable, gas storage vessels shall be manufactured and tested in accordance with a code of practice recognised by the Occupational Health and Safety Act. Measures shall be taken to prevent ingress of contaminants such as moisture and dirt as well as over-pressurising during the gas-filling process.

5.12.2.7 Where applicable, the management of SF₆ gas shall be in accordance with NRS 087.

5.12.2.8 In the case of SF₆ switchgear, the supplier shall render a service to recover and replenish SF₆ gas after its service life. Confirmation and details of this services shall be provided with the tender documentation (refer to 5.24.1).

5.13 PROVISIONS FOR POWER CABLE TERMINATIONS IN CABLE COMPARTMENTS

5.13.1 Cable compartments shall be suitable for the following cable termination types in accordance with NRS 012:

5.13.1.1 for switchgear panels rated up to and including 1250 A: type 4 cable terminations (outside cone screened separable connectors) – as shown in Figure 2; and

5.13.1.2 for switchgear panels rated above 1250 A: type 4 (outside cone screened separable connectors) or type 5 cable terminations (inside cone screened separable connectors) – as shown in Figure 2 and Figure 3 respectively.

5.13.2 Cable compartment design and construction (i.e. distances from cable support clamps to terminal fixing points, etc.) shall comply with the requirements of NRS 012.

5.13.3 All switchgear incomer and feeder panels shall be supplied with the number of bushings specified in column 3 of Table 5.

5.13.4 All switchgear incomer and feeder panels shall be designed to accommodate the number, type and size of cables specified in column 4 of Table 5.

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Table 5 – Number and type of cables according to panel rating

1	2	3	4
Panel rating [A]	Type of panel	Number of bushings per phase	Number, type and size of cables [mm ²]
630	Feeder	1	2 x 1-core / phase ≤ 300 mm ² Cu for 11 kV ≤ 185 mm ² Cu for 22 kV
1250	Incomer OR Feeder	1	2 x 1-core / phase ≤ 630 mm ² Cu 1-core
2000/2500	Incomer	2 (type 4 terminations) 4 (type 5 terminations) ¹⁾	4 x 1-core / phase ≤ 630 mm ² Cu 1-core

NOTE 1) Where surge arresters are specified (refer to 5.14), additional bushings are required for the screened surge arresters.

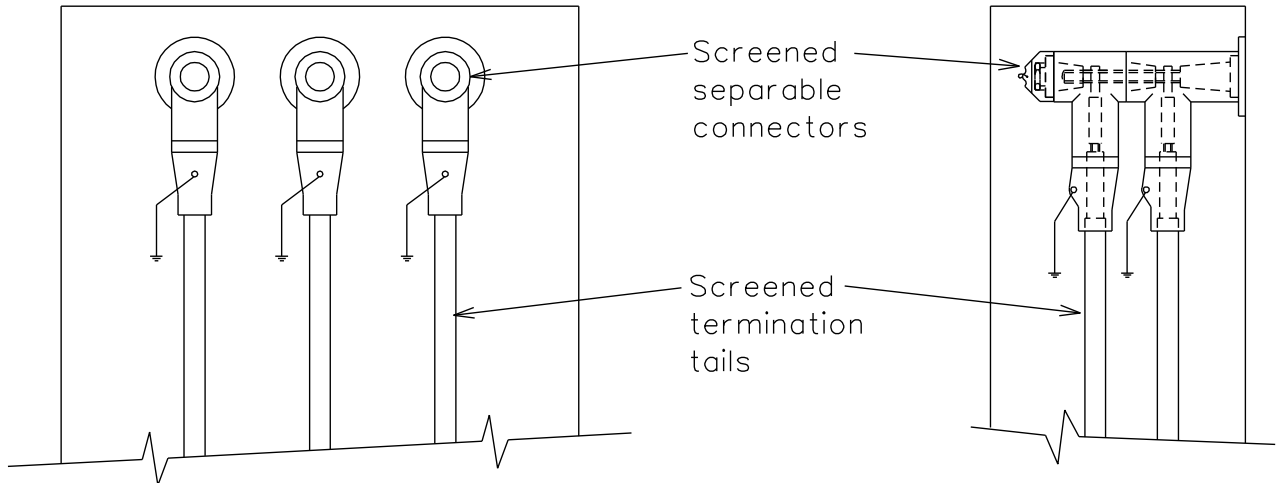


Figure 2 – Type 4 cable termination for 1-core cables

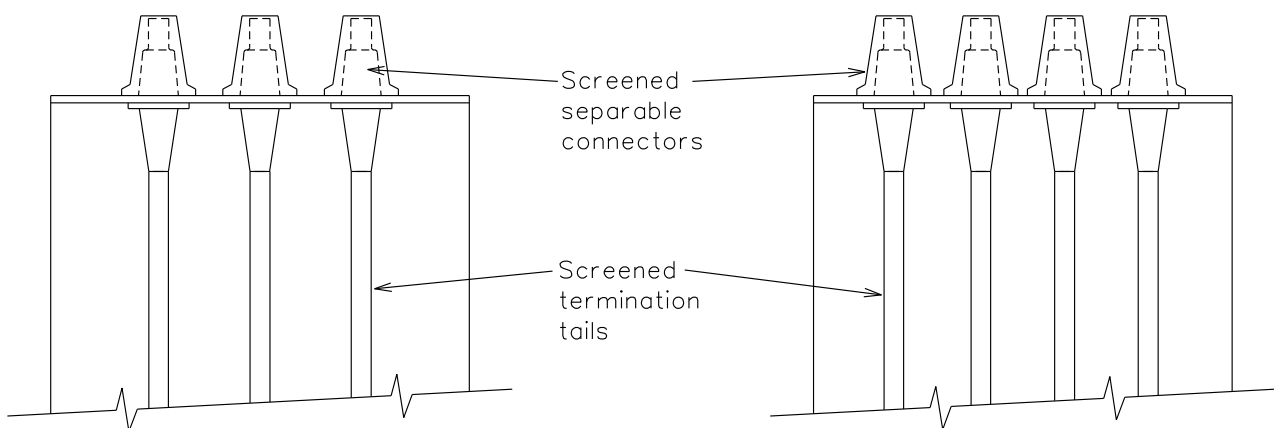


Figure 3 – Type 5 cable termination for 1-core cables (> 1250 A)

5.13.5 For feeder panels, unless otherwise specified in the switchgear ordering schedule, individual cable support clamps in accordance with NRS 012 and suitable for an unarmoured cable having an outer diameter range of 25 – 55 mm shall be fitted for each 1-core cable.

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5.13.6 For incomer panels, unless otherwise specified in the switchgear ordering schedule, individual cable support clamps in accordance with NRS 012 and suitable for an armoured cable having an outer diameter range of 50 – 75 mm shall be fitted for each 1-core cable.

5.13.7 The distance from the cable support clamp center line to the bushing center line shall be in accordance with Table 6 and as shown in Figure 4. The distance offered shall be stated in schedule B.

Table 6 — Distance from bushing center line to the cable support clamp

1	2	3	4
Symbol for clearance (Figure 4)	Cable type and size	Distance [mm]	
		Voltage rating of panel [kV]	
		12	24 and 36
e	Single-core cables : All sizes	600	600

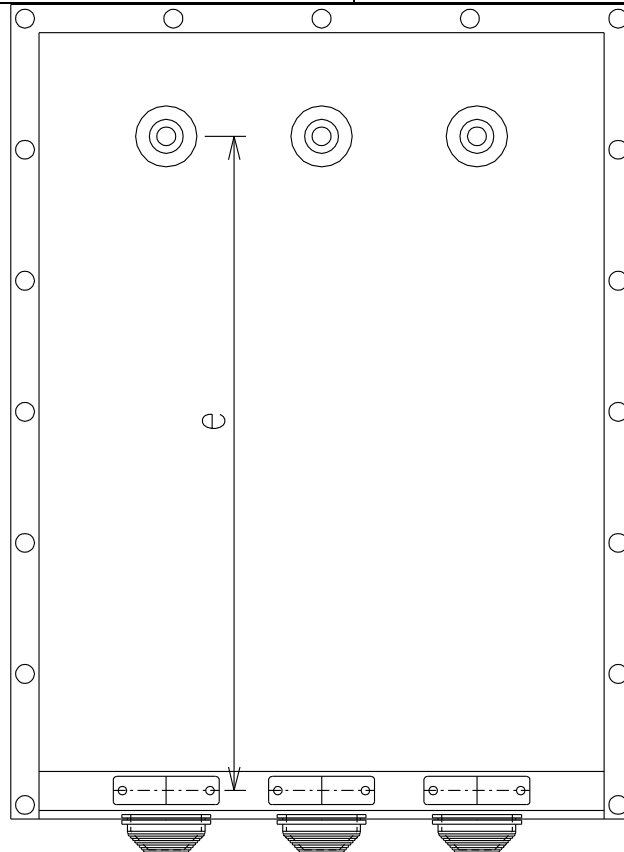


Figure 4 – Typical cable compartment for type 4 cable terminations showing distance from cable support clamp to bushing center line

5.13.8 Where vermin proofing plates are provided to seal off the bottom of the cable compartment, the plates shall be manufactured from a non-ferrous metal to prevent iron losses (induced eddy currents). The material and thickness of the vermin proofing plates offered shall be stated in schedule B. The vermin proofing plates shall have pre-drilled/punched cable entry holes that are positioned to correspond with the cable support clamp positions. Each hole in the vermin proofing plates shall be fitted with a grommet having a range-taking capability at least equivalent to that of the cable support clamp. The number of holes provided in the vermin proofing plate shall be suitable to accommodate the number of cables to be installed as indicated in Table 5.

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5.13.9 Suitably positioned copper earthing bars in accordance with 5.7.1 shall be provided in each cable compartment for the connection of each cable termination main earthing conductor. No more than two cable termination main earthing conductors shall be connected per hole (i.e. no more than one back-to-back connection per hole provided in the copper earthing bar). Each hole in the earthing bar shall be fitted with an M12 stainless steel or brass set screw, washer, spring washer and nut. The copper earthing bar(s) in each cable compartment shall be connected to the switchgear main earthing bar.

NOTE Each termination kit is supplied with a 700 mm main earthing conductor fitted with a lug having a M12 fixing hole. The length of the main earthing conductor available from the bottom of the cable termination to reach the earthing bar can be assumed to be 500 mm.

5.14 PROVISION OF SURGE ARRESTERS

NOTE When applicable (i.e. in the case of feeder panels supplying overhead lines), surge arresters will be specified and supplied with the Type 4 outside-cone screened separable connector cable terminations and will therefore not be supplied with the switchgear.

5.15 CABLE TEST FACILITIES

5.15.1 It shall be possible to connect cable test equipment (e.g. pressure testing or fault locating equipment) to the power cables via a cable test facility in a safe manner. The type of cable test facility offered shall be stated in schedule B.

NOTE Switchgear offering integral cable test facilities that are independent of the cable compartments, and thus eliminating the need to access and interfere with the cable terminations for cable testing, are preferred.

5.15.2 Where cable test facilities are provided that are independent of the cable compartment, an interlocking facility shall be provided that ensures that the cable test facility can only be accessed when the cable earth has been applied (i.e. when in the EARTH position).

5.15.3 When the cable test facility is in use, it shall not be possible to close the disconnect.

5.15.4 All cable test facilities shall be suitable for the application of test voltages associated with the on-site commissioning of power cables. For testing, the on-site test values shall be in accordance with SANS 10198-13.

5.15.5 Where applicable, the test plugs offered (refer to 5.23.1) shall be fully described in schedule B.

5.16 POSITION / STATUS INDICATION

5.16.1 Position / status indicators


5.16.1.1 Each switchgear panel (functional unit) shall include a mimic indicating the ON, OFF and EARTH positions of the main circuit.

5.16.1.2 The mimic shall be located on the front of the panel so that they can be viewed without opening any panel/door. The mimic indication shall be either mechanical or electronic (e.g. LCD display, LED indicators, etc.). The layout of the mimic shall be shown as part of the panel layout on the general arrangement drawings. Where applicable, a "lamp/display check" push-button function shall be provided which, when pressed, causes all indicators to be illuminated/displayed. Incandescent lamps shall not be used. The type of mimic shall be stated in schedule B.

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

- a) circuit-breaker contact status (open/closed);
- b) disconnect status (open/closed/earthing – as and where applicable); and
- c) earthing status (open/earthed).

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

- a) *closed* position: "I" in white lettering on a red background
- b) *open* position: "O" in white lettering on a green background
- c) *earthed* position:  (the earth symbol) in black on a yellow background

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5.16.1.5 Lettering size shall be at least 10 mm, unless otherwise approved by Eskom

5.16.1.6 The circuit-breaker closing spring status (charged or discharged) shall be indicated by a mechanical device, which is clearly visible with the mechanism enclosure 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.

NOTE Where electromagnetic mechanisms are offered, appropriate terminology will be required (e.g. "CAPACITORS CHARGED", etc.).

5.16.1.7 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 type of operation counter shall be stated in schedule B. The supplier shall submit full details of the operation counter on request by Eskom.

5.16.1.8 All status indicating devices shall be clearly visible from in front of the switchgear panel with the doors closed.

5.16.2 Cable and busbar live indication

An "integrated" voltage detection system (VDS) with fixed voltage indicators and test points in accordance with SANS 61243-5 shall be provided for cable live indication on each incomer and feeder panel. The VDS systems shall be fitted on the LV compartment door. A spare status contact from each VDS shall be wired to terminals in the LV compartment as per D-DT-5408.

5.16.3 Gas density indication (where applicable)

Where applicable, gas pressure gauges (compensated for temperature and responding to gas density) shall be provided for each gas-filled compartment.

5.17 LABELS AND COLOUR CODING

5.17.1 General

5.17.1.1 Labels inside switchboards and panels shall be made from non-conductive material.

5.17.1.2 Unless otherwise specified or agreed, labels shall be manufactured in accordance with DSP 34-1513 and D-DT-5049.

5.17.1.3 All labels and their methods of attachment shall be corrosion-resistant.

5.17.1.4 Unless otherwise specified or agreed, all external labels and signs shall be attached using rivets or self-tapping screws. Stick-on labels, double sided tape or glue are not accepted for external labels. Alternative methods used to attach internal labels and signs shall be subject to agreement with Eskom. The adhesive strength and durability of the method used to attach internal labels may be subject to rigorous quality checks by Eskom.

5.17.2 Warning labels

5.17.2.1 On top of the panels, the words "NO STEP" in black lettering shall be stencilled on the outside of the panels where the height of the panels is such that a person can stand on top of the busbar compartment.

5.17.2.2 Where applicable, busbar blanking plates shall be labelled "BUSBAR - DO NOT REMOVE" on the ends of switchboard.

5.17.3 Main circuit and switchboard designation labels

5.17.3.1 All main circuit designation labels shall be in accordance with DST 34-1439.

NOTE It is the responsibility of the Eskom project engineer to ensure that the main circuit designation labelling philosophy for each panel is in accordance with DST 34-1439.

5.17.3.2 The main circuit designation labels shall be engraved by the supplier according to the panel designation names provided in the switchgear ordering schedule.

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5.17.3.3 Main circuit designation labels shall be provided for all panels and shall be located on fixed positions on the front and back of each switchgear panel. Main circuit designation labels shall not be fitted on removable doors/covers.

5.17.3.4 Main circuit designation labels shall be provided for all busbar sections and shall be located at both ends of the busbar.

5.17.3.5 A switchboard designation label (i.e. station name) shall be provided for the entire switchboard and shall be located on a fixed position on the front of the switchboard.

5.17.4 Operating labels

5.17.4.1 Labels associated with local mechanical operation of the circuit-breaker shall be in English and shall be as follows (black text on white background):

- a) *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. These labels shall be located on the circuit-breaker as well as on the circuit-breaker compartment door.

NOTE Only the “TO TRIP CIRCUIT-BREAKER” instructions is to be indicated on the circuit-breaker compartment door. Refer to clause 5.9.8.

- b) *Instructions for charging the closing spring:* The instruction shall be titled “TO CHARGE SPRING” and located near the actuator for local mechanical spring charging. This label shall be located only on the circuit-breaker.

NOTE In the case of electromagnetic actuator mechanisms, this requirement is not applicable.

- c) *Instructions for earthing the cable and busbar:* These instructions shall be titled “TO EARTH CABLE” and “TO EARTH BUSBAR”. Additional information required to perform these functions shall be referred to Eskom. These labels shall be suitably located on each panel.

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

- a) 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;
- b) by actuating direction or position. A rotary switch shall be turned anti-clockwise 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 [IEC 60447]; and
- c) 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.

NOTES

1. The Eskom colour coding convention for open/close actuators is opposite to that specified in 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.

5.17.4.3 The stand-off remote control unit push buttons shall be identified in accordance with 5.17.4.2.

5.17.4.4 The switchgear tool cabinet (refer to 5.23) door shall be labelled as follows: “SWITCHGEAR OPERATING TOOLS AND MANUALS” (black text on white background).

5.17.4.5 Cable test facilities shall be labelled as follows: “CABLE TEST FACILITY BEHIND COVER” (black text on white background).

5.17.5 Function labels

5.17.5.1 All relays, instruments, fuses, MCBs, control switches, luminous indicators, plug-in female receptacles and links, the functions of which are not clearly identified by signs or pictograms, shall be clearly labelled to indicate their functions.

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5.17.5.2 These labels shall be in text using black letters at least 5 mm high on a white background.

5.17.5.3 Fuse labels shall include the fuse rating.

5.17.5.4 Where necessary, labels shall be repeated inside the switchgear panel or in the LV compartment (as applicable).

5.17.6 Colour coding

5.17.6.1 The switchgear panel LV compartment door shall be colour coded according to their function as specified in Table 7.

5.17.6.2 The tool cabinet shall be light grey in accordance with colour G29 of SANS 1091.

Table 7 – Colour coding of switchgear panel LV compartment doors

Panel Type	Colour	Colour number	NCS colour code
Incomer Panel	Signal Red	A11	1580-Y90R
Bus-section Panel	Spectrum Orange	B25	0580-Y60R
Feeder Panel	Cloud Grey	F48	2005-B

5.18 CURRENT TRANSFORMERS (CTS)

5.18.1 Current transformers shall be of the dry-type and manufactured and tested in accordance with SANS 60044-1. The make and type of CT offered shall be stated in schedule B.

5.18.2 The number of measurement and protection CT cores per phase, together with their position relative to the circuit breaker and their respective specifications (tappings, ratios, classes, burdens, knee-point voltage, excitation currents at knee-point voltages and secondary resistances – where applicable) shall be in accordance with D-DT-5408.

5.18.3 CT terminal numbering shall be in accordance with the relevant sheets of D-DT-5408.

5.18.4 The core arrangement shall be as shown in Figure 5.

NOTE It is important to note the primary polarity markings with respect to the core arrangement and position relative to the circuit-breaker.

5.18.5 CTs shall be properly fixed and mechanically supported so that no movement is allowed during transportation of service fault conditions.

5.18.6 CTs shall not be located inside any gas-filled compartment, unless accessible through suitably positioned repair openings. Unless otherwise approved by Eskom, CTs shall be accessible with only the circuit-side disconnected (isolated) for removal/replacement without extensive dismantling of the switchgear. The location of the CTs shall be stated in schedule B.

5.18.7 Where cable compartment block-type CTs in ambient air are provided, these shall be fully insulated and screened.

5.18.8 Where ring type CTs are provided, the arrangement shall ensure that the live conductors passing through the CTs are fully insulated and screened.

5.18.9 Where ring-type CTs are provided around the power cables, the inner dimensions of the CT shall accommodate the number and size of cables specified in column 4 of Table 5. The arrangement shall be subject to approval by Eskom.

5.18.10 One set of Protection CT cores shall be provided in bus section circuit-breaker applications

5.18.11 All current transformers shall have a rated short-time (thermal) and dynamic (peak) withstand current in accordance with Table 3. Where the short time current rating cannot be achieved (e.g. for lower ratio CTs), this shall be stated in schedule B.

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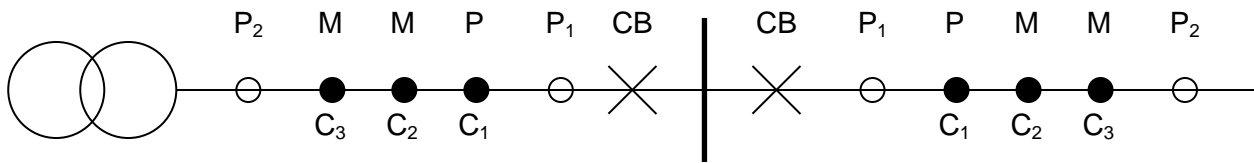


Figure 5 – CT positioning for all indoor applications

5.19 VOLTAGE TRANSFORMERS (VTS)

5.19.1 Busbar connected dry-type voltage transformers (VTs) shall be provided for each bus-section.

5.19.2 VTs shall be manufactured and tested in accordance with SANS 60044-2. The make of VT offered shall be stated in schedule B.

5.19.3 VTs shall be single-phase, fully insulated and screened.

5.19.4 VTs shall be of the plug-in type.

5.19.5 Suitable protection shall be provided to prevent ferro-resonance. Details regarding the protection offered shall be provided with the tender documentation (refer to 5.24.1).

5.19.6 A suitable means to disconnect the VT from the busbar shall be provided. Details shall be provided with the tender documentation (refer to 5.24.1).

5.19.7 The VT specification (ratio, class, rated voltage factor and core construction) shall be in accordance with the relevant sheet of D-DT-5408.

5.19.8 The VT terminal numbering shall be in accordance with the relevant sheets of D-DT-5408.

5.20 AUXILIARY AND CONTROL CIRCUITS

The auxiliary and control circuits shall be designed and wired in accordance with 240-56063705 and D-DT-5408.

5.21 ARC DETECTION PROTECTION SYSTEM EQUIPMENT

NOTE Internal arc detection protection systems are not recommended for fixed pattern switchgear. It is however recommended that users employ a suitable busbar blocking protection scheme that operates in the unlikely event of a busbar fault. Refer to DGL 34-933 for further information.

5.22 NAMEPLATES

5.22.1 Each switchgear panel shall be provided with a nameplate in accordance with the requirements of SANS 62271-200. In addition to the requirements of SANS 62271-200, the Eskom order number shall be included on the switchgear panel nameplate.

5.22.2 The following additional information shall be provided for the circuit-breaker operating mechanism:

- type designation
- trip-coil voltage, current, d.c. resistance (at 20 °C)
- close-coil voltage, current, d.c. resistance (at 20 °C)
- motor voltage and current (starting peak current and nominal running current)

5.22.3 Each current transformer and voltage transformer shall be separately labeled in accordance with the nameplate requirements of SANS 60044-1 and SANS 60044-2 respectively.

5.22.4 The switchgear panel nameplate shall be located on the front of the panel.

5.22.5 A duplicate nameplates for the voltage transformer associated with the specific switchgear panel shall be located on the inside of the LV compartment door.

5.22.6 Duplicate nameplates for the current transformers shall be located on the inside of the LV compartment door.

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5.22.7 The actual ratings to which the equipment (e.g. circuit-breaker) has been type-tested (and not merely the values specified) shall be displayed.

5.22.8 Nameplates shall be manufactured using intrinsically corrosion-proof metal (e.g. aluminium / stainless steel) and securely attached. The method used to attach the nameplates shall be subject to approval by Eskom. Information shall be durably (e.g. engraved) and legibly applied. The nameplate material shall be stated in schedule B.

5.23 TOOLS AND SPARES

5.23.1 A full set of operating tools necessary to carry out all mechanical operation of the switchgear shall be supplied with each switchboard (e.g. operating handles, , set of cable test plugs, etc.). A full list of operating tools shall be provided with the tender documentation (refer to 5.24.1). If additional sets of operating tools are required, this shall be specified in the switchgear ordering schedule.

5.23.2 A hand-held remote control unit for remote operation (remote switching) of the switchgear shall be supplied with each switchboard. If additional hand-held remote control units are required, this shall be specified in the switchgear ordering schedule.

NOTE The cost of all the above tools / equipment is included in the cost of the switchboard.

5.23.3 A wall-mounted steel tool cabinet with the tool positions and applications clearly marked shall be supplied and installed with each switchboard for the storage of all operating tools, the hand-held remote control unit and test jumpers (if required).

5.23.4 The tool cabinet shall be fitted with a robust fastening arrangement (suitable locking lever/handle). Each door handle shall be capable of being secured by a padlock that has a shackle diameter of 6 mm.

5.23.5 A steel documentation pocket suitable for all A4 sized manuals, routine test certificates etc. shall be supplied and fitted on the inside of the tool cabinet door.

5.23.6 The colour of the tool cabinet shall be in accordance with 5.17.6.

5.23.7 Corrosion protection of the tool cabinet shall be in accordance with 5.11.5.

5.23.8 The tool cabinet shall be labelled in accordance with 5.17.4.4.

5.23.9 A detailed list of standard tools required for minor maintenance shall be supplied with the tender documentation (refer to 5.24.1).

5.23.10 Should the switchgear require additional specialised tools for major (specialised) maintenance purposes, a full list of specialised maintenance tools shall be provided with the tender documentation (refer to 5.24.1).

NOTES

1. Separate prices are quoted in the pricing schedules for equipment described in 5.23.9 and 5.23.10.
2. This equipment will normally be consigned to the same site as the switchboard.
3. Allowance should be made to supply at least one set of tools for each site.

5.23.11 A full list of spares required for maintenance shall be provided with the tender documentation (refer to 5.24.1).

5.23.12 A set of basic spares required for maintenance (i.e. 2 x trip coils, 2 x close coils) shall be supplied with each switchboard.

NOTE The cost of these spares is included in the cost of the switchboard.

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5.24 DOCUMENTATION REQUIREMENTS

5.24.1 The supplier shall provide the following documentation with each tender (in electronic pdf format using appropriate document and folder names):

- a) completed technical schedule B and deviation schedule for each panel type and rating. 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 (i.e. properly annotated drawings with complete list of major components) clearly showing the following minimum information:
 - manufacturer's drawing number and revision number;
 - descriptive title of the drawing (e.g. "12 kV 1250 A Incomer Panel General Arrangement Drawing");
 - busbar and main circuit rated current;
 - critical dimensions/information including the following:
 - overall panel dimensions,
 - location and overall dimensions of various compartments as defined in this specification,
 - location of internal arc pressure relief flaps, and
 - position of earth terminals or bars;
 - incomer and feeder panel drawings shall show the following additional information:
 - cable compartment overall dimensions,
 - position of vermin proof plates, cable support clamps and rubber grommets,
 - distance from cable support clamps to terminal fixing center line,
 - spacing between cable terminal fixing points (phase to phase and phase to earth),
 - distance from terminal fixing point to cable compartment door,
 - location of surge arresters and dedicated fixing points (where applicable),
 - location of CTs,
 - location of cable termination earth terminals or bars,
 - cable trench overhang dimensions,
 - minimum width of cable trench required, and
 - minimum distance required from the rear of the panel to rear switch room wall;
 - circuit-breaker panel drawings shall show the following additional information:
 - location of circuit-breaker and operating mechanism,
 - location of mechanical trip button, and
 - location of status indication;
 - location of all mechanical operating tool insertion positions (as applicable for each panel type);
 - position and wording of all labels specified in this specification;
 - location and layout of LV control cable gland plates;
 - lifting eyes and transportation details - including required clearance above panel if lifted with crane;
 - mass of switchgear panel;
 - location of panel nameplate; and
 - foundation / holding down bolt fixing details;
- c) drawings showing the generic layout of all the nameplates (panels, circuit-breakers, disconnectors, earthing switches, CTs, VTs) specified in this specification;
- d) generic auxiliary and control circuit schematic wiring diagrams for each panel type and rating in accordance with 240-56063705 ;
- e) full list of operating tools (refer to 5.23.1);
- f) detailed list of tools required for minor maintenance (refer to 5.23.9);
- g) detailed list of additional specialised tools for major (specialised) maintenance (refer to 5.23.10);

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- h) full list of spares required for maintenance (refer to 5.23.11 and section 8.3);
- i) a full list as well as copies of type test certificates and reports as specified in the specification;
- j) generic routine test certificates for each panel type;
- k) transport, storage, installation, operating & maintenance manuals (refer to section 9);
- l) training material (refer to section 10); and
- m) the submission, where applicable, of the following additional information:
 - details regarding the procedure for the on-site replacement of a damaged/faulted panel in a switchboard, including the necessary in-situ gas-work – where applicable (refer to 5.2.4);
 - details of the effect of reduced internal gas-pressure on the operation, safety and insulation levels of the switchgear – where applicable (refer to 5.2.12);
 - details of internal arc pressure relief / absorption / cooling devices and ducting – where applicable (refer to 5.6);
 - special requirements or limitations for installation (refer to 5.11.1.2);
 - details of steel support frame / base for installation of panels over the cable trench (refer to 5.11.1.5);
 - details of the fully screened solid dielectric insulated busbar system offered (where applicable) (refer to 5.11.4.1);
 - all information requested relating to gas-filled compartments (refer to 5.12.2);
 - details regarding the VT protection offered to prevent ferro-resonance (refer to 5.19.5);
 - details of the means offered to disconnect the VT from the busbar (refer to 5.19.6);
 - quality control plans indicating all inspection hold points (refer to 7.2.3);
 - details of equipment requiring maintenance during storage (refer to 7.5.1);
 - a written commitment from the supplier regarding the submission of the maintenance DVD (refer to 8.2); and
 - spares availability philosophy (refer to 8.3.2).

5.24.2 The supplier shall submit the following documentation with each switchboard delivered to Eskom before hand-over stage:

- a) a schematic wiring diagram for each panel type;
- b) a complete set of routine tests for each panel;
- c) a commissioning and hand-over test sheet; and
- d) one set of transport, storage, installation, operating and maintenance manuals.

5.24.3 The documentation supplied with the switchboard shall be stored in the documentation pocket inside the wall-mounted steel tool cabinet.

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

5.24.4 The supplier shall provide with the tender a proposal for condition monitoring functions and sensors that can be supplied with each panel type.

5.25 PACKAGING REQUIREMENTS

The switchgear shall be fixed onto pallets and/or packaged in such a manner so as to prevent damage to the corrosion protection of the enclosure during transportation.

The packaging must be suitable for storage on site for up to 12 months prior to installation.

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6 TESTS

6.1 GENERAL

6.1.1 Manufacturer's testing capabilities

The supplier 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.

6.1.2 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, after completion of all preliminary tests, shall then give Eskom sufficient, agreed upon, advanced notice of the firm date when the metal enclosed circuit-breaker panel and associated apparatus will be ready for the witnessing of testing. For overseas switchgear manufacturers the minimum required notification time period is 8 weeks.

Eskom shall be notified within 24 hours 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.

6.1.3 Test certificates and reports

6.1.3.1 Type test certificates together with each complete test report (in English) shall be supplied with the tender documentation (refer to 5.24.1) in electronic format (pdf).

6.1.3.2 Generic copies of the routine test certificates/reports shall be supplied with the tender documentation (refer to 5.24.1) in electronic format (pdf). The test certificate shall indicate (make provision for) the tests performed, results, identification of the equipment tested, etc.

6.1.3.3 One hardcopy of the routine test certificates/reports shall be supplied with each switchboard and stored in the documentation pocket inside the wall-mounted steel tool cabinet. In addition to the hardcopy, the routine test certificates/reports shall be made available in electronic format and submitted to Eskom

6.2 TYPE AND ROUTINE TEST REQUIREMENTS

6.2.1 The manufacturer shall perform a complete set of type tests for each design as well as routine tests on each unit. The type test certificates and reports shall be submitted for review during the tender or product evaluation stage.

6.2.2 The indoor switchgear panels (functional units) shall be type tested in accordance with SANS 62271-200 and shall include the following tests:

- a) equipment insulation level (SANS 62271-200 6.2);
- b) temperature rise and measurement of resistance of circuits (IEC 62271-200 6.5 & 6.4);
- c) current withstand – main circuit (SANS 62271-200 6.6);
- d) current withstand – earthing circuit (SANS 62271-200 6.6);
- e) circuit breaker short-circuit making and breaking capacities (SANS 62271-200 6.101 and SANS 62271-100 6.102 to 6.106);
- f) circuit-breaker critical current tests (where applicable) (SANS 62271-100 6.107);
- g) circuit-breaker double earth fault tests (SANS 62271-100 6.108);
- h) circuit-breaker out-of-phase making and breaking tests (applicable if an out-of-phase rating is assigned) (SANS 62271-100 6.110);
- i) circuit-breaker capacitive current switching tests (SANS 62271-100 6.111.5);
- j) circuit-breaker electrical endurance tests (SANS 62271-100 6.112);
- k) earthing switch making capacity (SANS 62271-200 6.101 and SANS 62271-102 6.101) – where applicable;
- l) circuit-breaker mechanical operation test (SANS 62271-200 6.102 and SANS 62271-100 6.101.2.1 - 6.101.2.3);
- m) circuit-breaker extended mechanical endurance tests (for class M2 circuit-breakers) (SANS 62271-100 6.101.2.4);

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- n) disconnecter operating and mechanical endurance tests (SANS 62271-200 6.102.1 and SANS 62271-102 6.102);
- o) earthing switch mechanical operation (SANS 62271-200 6.102) – where applicable;
- p) test to verify the proper functioning of the position indicating device for the disconnecter (SANS 62271-102 6.105);
- q) verification of the protection (IP coding and mechanical impact) (SANS 62271-200 6.7);
- r) tightness test (SANS 62271-100 6.8);
- s) X-radiation test procedures for vacuum interrupters (SANS 62271-200 6.11);
- t) internal arc (SANS 62271-200 6.106);
- u) partial discharge test (SANS 62271-200 6.2.9);
- v) dielectric tests on cable testing circuits (SANS 62271-200 6.2.101); and

NOTE The relevant cable standard for cable testing is SANS 10198-13. Test voltages of up to $3 \times U_0$ are applicable for on-site cable commissioning tests.

- w) additional tests on auxiliary and control circuits (SANS 62271-200 6.10).

6.2.3 The indoor switchgear shall be routine tested in accordance with SANS 62271-200 and shall include the following tests:

- a) dielectric test on the main circuit (SANS 62271-200 7.1);
- b) tests on auxiliary and control circuits (SANS 62271-200 7.2);

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

- c) measurement of the resistance of the main circuit (SANS 62271-200 7.3);
- d) tightness test (SANS 62271-200 7.4);
- e) design and visual checks (SANS 62271-200 7.5);
- f) partial discharge measurement (SANS 62271-200 7.101);
- g) mechanical operating tests (SANS 62271-200 7.102 and SANS 62271-100 7.101, SANS 62271-102 7.101);
- h) pressure tests of gas-filled compartments – if applicable (SANS 62271-200 7.103); and
- i) tests of auxiliary electrical devices (SANS 62271-200 7.104).

6.2.4 The following quantities shall be measured and recorded during the mechanical operating tests (where applicable):

- a) closing and opening speeds;
- b) closing and opening times;
- c) time taken to recharge the mechanism following an O, C and OCO operation;
- d) synchronism across phases and between breaks of phases for an O, C and OCO operation;
- e) timing tests on each type of auxiliary switch contact in relation to the main contacts;
- f) time-current curves of the electrical tripping and closing circuits for normal operation. The resolution of the function times shall clearly be indicated on the test reports.

6.2.5 CTs shall be type and routine tested in accordance with SANS 60044-1.

6.2.6 VTs shall be type and routine tested in accordance with SANS 60044-2.

6.2.7 Additional special tests required (if applicable) will be specified in schedule A.

6.3 TESTS AFTER INSTALLATION ON SITE (PRE-COMMISSIONING TESTS)

6.3.1 Commissioning checks and a test programme (as determined by the manufacturer) shall be carried out in accordance with SANS 62271-200 7.105 and SANS 62271-100 10.2.101 – 10.2.102. This shall include checks after installation, circuit-breaker mechanical tests and measurements, checks of certain specific circuit-breaker operations and electrical tests and measurements.

6.3.2 Tests shall include, but are not limited to, the following:

- a) 80 % power-frequency voltage tests of the main circuits in accordance with SANS 62271-200 7.105;

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- b) tightness tests for vacuum switchgear in accordance with SANS 62271-200 7.105 (dielectric test across the open contacts at a voltage stated by the manufacturer);
- c) measurement of fluid condition after filling on site in accordance with SANS 62271-200 7.106; and
- d) verification of remote control operation using the hand-held remote control unit for circuit-breaker switching.

6.3.3 Mechanical tests and measurements on the circuit-breakers may include, but are not limited to, the following:

- a) verification of the rated operating sequence; and
- b) measurement of time quantities.

6.3.4 Checks of certain specific operations for the circuit-breakers may include, but are not limited to, the following:

- a) Simulation of fault-making operation and check of anti-pumping device;
- b) behaviour of the circuit-breaker on a closing command while an opening command is already present; and
- c) application of an opening command on both releases simultaneously.

6.3.5 Electrical tests shall include, but are not limited to, the following:

- a) measurement of resistance of the main circuits of the assembly in accordance with SANS 62271-200; and
- b) dielectric tests on auxiliary and control circuits in accordance with SANS 62271-200.

6.3.6 For each measurement of the operating time, a recording shall be made of each individual operating coil current – namely close, trip I, trip II. The resolution of the function times shall be clearly indicated in the test reports.

6.3.7 For the measurement of the steady-state contact resistance of the main circuit, a d.c. current of at least 50 A shall be used. The results shall be given in $\mu\Omega$ and the resolution shall be at least 1 $\mu\Omega$.

6.3.8 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.

6.3.9 The results of pre-commissioning tests after installation on site shall be documented, signed off and a copy of the results included with the switchgear documentation for hand-over as part of the quality process. All tests shall be witnessed by Eskom. Refer to 7.7.2 for further information on the pre-commissioning test report.

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7 MANUFACTURING, TRANSPORTATION, STORAGE AND INSTALLATION AND PRE-COMMISSIONING

7.1 General

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

7.1.2 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 5.24.1).

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

7.2 INSPECTION OF MANUFACTURING FACILITIES AND SWITCHGEAR

7.2.1 Eskom or the nominated representative reserves the right to inspect and evaluate all manufacturing facilities relating to the switchgear offered.

7.2.2 Eskom or the nominated representative reserves the right to inspect any ordered switchboard before shipment, or at any stage of manufacture. This inspection will entail a thorough check to ensure complete compliance with this specification, switchgear schedules and the approved drawings.

7.2.3 With the tender documentation (refer to 5.24.1), the supplier shall submit the quality control plans to Eskom, indicating all inspection hold points. Eskom may add the necessary inspection hold and/or witness points for Eskom or its appointed representative. The supplier shall make due allowance for these activities in the manufacturing programme and, to avoid delays, shall give sufficient, agreed upon, advanced notice of the date of inspection. Eskom will not accept late delivery on the basis of inspection delays.

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

7.2.4 Deviations in the switchgear design shall be pointed out in accordance with the tendered deviation schedule and the type test certificates provided for the specific functional unit design. No clearance shall be given where there is no satisfactory evidence of the relevant type test certificates, where such tests are required.

7.2.5 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.

NOTE A model factory acceptance test (FAT) checklist is shown in Annex C.

7.3 Conditions during transportation, storage and installation

7.3.1 Conditions can be expected to be onerous during transport, storage and installation. Adequate precautionary measures shall be provided for the protection of sensitive components such as circuit-breakers and operating mechanisms during transport, storage and installation.

7.3.2 Vibrations and impacts during transport shall also be considered. Impact indicators must be installed on each circuit breaker which must indicate when an impact exceeding the design limits have been experienced. The indicators must indicate impact in all planes, i.e. longitude, latitude and vertical and must not be resettable. Any operation of the impact recorders must be reported to Eskom prior to installation.

7.3.3 The equipment shall be designed, manufactured and packaged appropriately to contend with the conditions arising during shipping and handling. The supplier shall demonstrate – either by testing or through previous satisfactory experience – that the equipment complies in this respect. Testing may include the following:

- a) shipping test: this test shall cover all the conditions to be encountered during transportation from factory to the designated site, including loading/off-loading from one mode of transport to another;
- b) vibration test: this test may be used to supplement actual shipping tests to check for unexpected shortcomings in the equipment and packaging; and

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- c) weatherproof test: this test may demonstrate the adequacy of the packaging to prevent ingress of moisture and water from weather or sea conditions.

7.3.4 If the design of the equipment is mature, and the equipment has previously been shipped under similar conditions, the above tests may be waived at Eskom's discretion.

7.4 Transportation, off-loading and storage

7.4.1 Refer to 5.25 for the requirements for packaging for transportation and storage.

7.4.2 The supplier shall be responsible for the transportation and off-loading of the equipment on site. Off-loading includes transportation from the point of off-loading the equipment after transportation to the point of installation.

7.4.3 The supplier shall provide his own means of off-loading at the point of installation.

7.5 Storage

7.5.1 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 5.24.1) as well as with orders upon awarding of a contract.

7.5.2 At the time of off-loading at an Eskom facility, the supplier has the responsibility to ensure that the necessary steps are taken by Eskom to ensure satisfactory storage.

7.5.3 Where heaters need to be energized, a clearly marked electrical connection point shall be provided to enable Eskom to supply power to the heaters without unpacking the equipment.

7.5.4 The supplier shall implement proper storage and handling procedures. A copy of the storage and handling procedures shall be made available to Eskom for acceptance (refer to 5.24.1). This shall indicate the maximum recommended period of storage, as well as recommended actions to be taken if a longer storage period is required.

7.6 INSTALLATION

7.6.1 The supplier shall be responsible for the installation and pre-commissioning of the equipment. This includes the supply of all installation tools, lifting tackle and test equipment.

NOTE Eskom will normally be required to complete all civil work for the switchroom.

7.6.2 Installation includes the drilling of holding-down bolt holes, supply and installation of mounting rails (where necessary), leveling / shimming of the switchgear, grouting where necessary, etc.

7.6.3 The installation instructions provided by the supplier (refer to 5.24.1) according to the OEM's instructions shall at least include the items listed below:

- a) 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;
- b) 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;
- c) mounting: instructions for mounting the switchgear shall include sufficient details to enable site preparation to be completed. These instructions shall also indicate:
 - the total mass of each panel; and
 - the mass of the heaviest part of the switchgear 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 switchgear shall be trained and accredited by the OEM. Proof of this accreditation shall be included in the quality control plan and shall be submitted to Eskom for approval prior to installation and pre-commissioning of equipment by the individuals concerned; and

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- e) final installation inspection and testing: instructions shall be provided for inspection and testing after the switchgear and controlgear has been installed and all the interfacing connections have been completed. These instructions shall include the following:
 - a) procedures for carrying out any adjustment that may be necessary to achieve correct operation;
 - b) recommendations for any relevant measurements that should be made and recorded to help with future maintenance decisions; and
 - c) instructions for final inspection and testing.

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

7.6.5 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), necessary for the performance of the work.

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

7.6.7 Power supplies for installation purposes can be made available on the construction site.

7.7 PRE-COMMISSIONING

7.7.1 Each functional unit as well as the complete assembly shall be tested after installation in accordance with 6.3 to assure proper installation and that no damage occurred during transportation. To facilitate the testing, adequate power supplies, test equipment and suitable qualified personnel shall be provided by the supplier.

7.7.2 A circuit-breaker pre-commissioning test report shall be submitted to Eskom, comprising the following parts:

- a) after the measurements at the substation site, a hand-written pre-commissioning test report shall be handed over to the appointed Eskom representative/official;
- b) within three weeks after the pre-commissioning tests, the supplier shall submit an official report to Eskom (two hardcopies); and
- c) an electronic copy of the official report shall be provided on a CD for each individual 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.

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

7.7.2.1.1 test/measuring equipment information/data:

- make and type of instruments;
- serial numbers of instruments;
- methods of triggering;
- measuring methods;
- the accuracy of the instruments; and
- calibration certificates of the measuring instruments used.

7.7.2.1.2 the switchgear data:

- make and type (switchgear and circuit-breakers);
- serial numbers of circuit-breakers and mechanisms;
- rated circuit-breaker voltage, normal current and short-circuit breaking current;
- the name of the substation or switching station;
- circuit-breaker panel identification and application;
- date of commissioning; and
- date and time of testing/measuring.

7.7.2.2 Clear copies of the complete printouts of the 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.

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

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

7.8 Safety related data (where applicable)

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

7.9 Requirements for pressure vessels (where applicable)

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

8 INSPECTION AND MAINTENANCE

8.1 GENERAL

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

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

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- switching operations (accumulated switching amperage);
- total number of operations;
- environmental conditions; and
- measurement and diagnostic tests for condition monitoring.

Scope of work to be performed: It shall include the following:

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

Graphical information: Detailed drawings and sketches of the circuit-breaker 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.

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

- pressure levels (where applicable);
- operating times and contact velocities;
- resistance of the main current carrying circuits;
- insulating liquid or gas characteristics;
- quantities and quality of liquid or gas;
- torque settings for fasteners; and
- important dimensions.

Specifications for materials: This includes warnings of known non-compatibility of materials.

- fluid; and
- cleaning and degreasing agents.

Tools, lifting and access equipment: A list of standard and specialised tools shall be provided with description of their application and associated part number.

Tests after the maintenance work: All tests shall be clearly described and shall include the parameters to be observed.

Spare parts: Description, reference number, quantities and advice for storage.

Time estimates: Estimated time required to carry out maintenance activities.

Detailed information: This relates to the recommended makes and types of transducers (linear or rotary) to facilitate the measurement of travel curves. Such transducers (as well as the brackets, fittings and so forth that are needed to apply them on the 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.

8.2 MAINTENANCE DVD

It is anticipated that maintenance intervals for the circuit-breakers will be very long, e.g. several years. Consequently, it is essential that the instruction manual be supplemented and supported by a maintenance-orientated video recording. The video recording shall be converted into a suitable DVD format. A written commitment from the supplier regarding the submission of the DVD shall be provided with the tender documentation (refer to 5.24.1). The actual DVD shall be supplied upon awarding of the contract. 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.

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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 both produce the DVD and present the results in definite sections, covering the various aspects or portions of the equipment.

These sections may be on separate DVD's or if consolidated into a single DVD, there shall be adequate indexing to permit quick access to the desired section.

For each piece of equipment requiring maintenance, the DVD shall show:

- the tools, equipment and materials required to perform the maintenance, especially any special tools;
- the tests required prior to maintenance operations to record the status of the equipment and/or to indicate the areas requiring maintenance/re-adjustment;
- the disassembly steps, including any marking of positions required prior to disassembly, any discharging of pressure and/or stored energy;
- the disassembly, removal, replacement and re-assembly of any sub-components requiring scheduled maintenance/replacement;
- the re-assembly, realignment and re-installation of all components, including any lubrication of moving parts;
- a brief summary of the evacuation, refilling and leak testing of the re-assembled equipment;
- the testing of the re-assembled equipment, including acceptable values and tolerances of the measured/tested parameters; and
- some trouble-shooting methods if the required tolerances are not achieved.

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

8.3 SPARES

8.3.1 General

Spares will normally be purchased at the same time that orders are placed for circuit-breakers. The supplier shall provide a list of the minimum recommended spares (refer to 5.23.11) together with prices in the pricing schedules for the circuit-breakers concerned.

8.3.2 Availability of spares

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

Spares required under emergency breakdown conditions shall be readily available with a maximum lead time of 96 hours from date of purchase order. The supplier shall state the lead time offered in schedule B. This excludes spares required for scheduled maintenance.

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

- trip coils;
- close coils;

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- spring charging motors; and
- disconnecter operating motors.

The supplier shall undertake to supply to Eskom all the necessary replacement parts for the circuit-breaker throughout its expected service life. If the manufacture of the specific make and type of circuit-breaker (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 circuit-breaker 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 5.24.1).

8.3.3 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.

8.3.4 Packaging and storage of spares

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

8.4 MODIFICATIONS TO CIRCUIT-BREAKERS DURING THEIR SERVICE LIFE

If, during the normal service life of a circuit-breaker supplied, Eskom requires to be notified about a necessary modification, a field service bulletin shall be issued to the Eskom contract manager and relevant technical specialists giving details of the modification and the reason for it.

9 MANUALS

9.1 GENERAL

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

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

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

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9.2 CONTENT

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

- the manuals shall be written in English only;
- it shall be specifically compiled for the circuit-breaker with which it has been supplied;
- torque wrench settings, clearances, settings and other important information shall be listed, e.g. the typical operating times, speed curves and tolerances in synchronism;
- it shall give a clear description of the operation, and the diagrams and description shall be easily read together;
- routine inspection, minor and major maintenance procedures shall be given together with a list of lubricants, recommended spares and/or special tools and so on, required for these activities;
- it shall contain high-quality diagrams showing details of operating components of the circuit-breaker, which also identify and list separately each component making up the diagram;
- seals and gaskets requiring replacement during overhaul shall be detailed and the suppliers of these components, together with the part number(s), shall be listed; and
- the names and addresses of suppliers of lubricants, oils, gases, compounds and so on shall be listed.

One set of sample manuals shall be supplied to Eskom with the tender documentation (refer to 5.24.1) for approval. After approval, the requisite number of manuals shall be supplied.

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

General

- title page: title of equipment, equipment ratings, contract and order numbers, supplier's reference numbers. This information shall also appear on the outside of the binder and on the first page;
- table of contents: the manual shall be sectionalised and numbered sequentially;
- equipment make and type to which the manuals apply;
- list of all drawings, by number and title;
- description and summary of switchgear and circuit-breaker operation;
- full details of method adopted for anti-pumping;
- where applicable, details of auto-reclosing arrangements;
- schematic wiring diagrams of switchgear; and

Transport and storage instructions

- packaging requirements;
- transport instructions;
- storage instructions: special information for equipment storage; and
- the measures required to make sure all the manufacturer's transportation and storage requirements are met.

Installation instructions

- complete step-by-step instructions and detailed drawings, including alignment, installation and dimensional tolerances for preparing the equipment for service;
- inspection procedures before and after unloading, pre-installation tests, gas-filling and monitoring procedures;
- the levels of expertise required for the construction team;
- a man-hour estimate for the installation work required on site;

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- a list of special equipment and tools required for unloading and positioning components of the switchgear on site; and
- tolerances for field assembly.

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

Testing

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

Inspection and maintenance

- the maintenance manual shall contain the typical contents as described in 8.1.

Dismantling, repair, settings inspection and lubrication

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

Spare parts

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

Drawings for equipment

- a complete set of approved drawings specific to the equipment being supplied. The drawings shall show dimensions and tolerances of the major components and assemblies. Details of the drawings required are given in 5.24.

10 TRAINING

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

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

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11 SAFETY, HEALTH, ENVIRONMENT AND QUALITY

Refer to ESP 32-1188 for Eskom's health and safety management requirements for suppliers.

Refer to ESP 32-642 for Eskom's quality management requirements for suppliers.

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12 KEYWORDS

switchgear, metal-clad, metal-enclosed, indoor, circuit-breaker, switchboard, primary switchgear, fixed pattern, GIS, gas-insulated switchgear

13 AUTHORISATION

This document has been seen and accepted by:

Name & Surname	Designation
	The Rev 1 Document Approved by TDAC ROD 13 March 2013
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14 REVISIONS

Date	Rev.	Compiler	Remarks
November 2012	0	B Mwarehwa	Draft document for Review created from DSP 34-1702
May 2013	1	B Mwarehwa	Final Document for Publication
August 2013	2	T. Du Plessis/ B. Mwarehwa/ C. Bosch	Document revised to: Table 2 – Option for 33 kV 1250A rated busbar added on table 2. Table 3 – Option for 31.5 kA rated panels for 11 kV and 22 kV added. 4.7.2 Reference to the earthing switches in clause removed. 5.9.3.2 Alternatively the controls may be without unique colour - option removed. 5.11.2.4 Added Onboard protection panel requirements 5.18.10 One set of Protection CT cores shall be provided in bus section circuit-breaker applications

15 DEVELOPMENT TEAM

The original specification DSP 34-1702 was compiled by Johan Jordaan and revised by Rhett Kelly.

The first revision of 240-56062704 was compiled by Brighton Mwarehwa and Thinus Du Plessis

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16 ACKNOWLEDGEMENTS

- None

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APPENDIX A: SUPPLIER AND ESKOM RESPONSIBILITIES

(Normative)

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 the following:

- a) upon submission of a tender, the submission of a complete set of technical documents as required by this specification (refer to clause 5.24 **Error! Reference source not found.** for documentation requirements). 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;
- b) all testing and recording of results required by this specification as well as the OEM's own protocols using accredited resources including the use of approved and calibrated tools and test equipment. Type testing shall be carried out in accordance with the relevant IEC product standards. All testing shall be done at accredited local test facilities (SANAS accredited - e.g. SABS) or accredited international testing authorities (e.g. KEMA/CESI/IPH);
- c) in the case of first-time supply, the installation 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) all necessary arrangements for factory acceptance, transporting and off-loading at the most convenient point (if applicable), as well as for transporting and off-loading at the ultimate destination. Eskom will only accept delivery to the destination specified at the time of placing the order - unless otherwise negotiated;
- e) the supply of the complete switchboard assembly (all switchgear panels including circuit-breakers, CTs, VTs, etc.) in accordance with the Eskom switchgear ordering schedule;
- f) the supply and fitment of all necessary auxiliary and control equipment, including operating mechanisms, heater control circuits, terminal strips, alarm circuits, circuit-breaker ancillary functions and control circuit interlocks, control equipment, monitoring and protective devices. The interface of the switchgear auxiliary and control equipment to external control cabling shall be wired and numbered as per relevant sheets of D-DT-5408;
- g) the supply and fitment of all auxiliary and control wiring and terminations for the complete switchboard in accordance with the Eskom approved schematic wiring drawings (no additional auxiliary and control wiring on site is allowed);
- h) the supply and fitment of the switchgear support frame/base;
- i) if applicable, the fitment and wiring of the "on-board" protection and control schemes in the LV compartments;
NOTE In order to optimise and streamline manufacturing processes, the logistical arrangements and supply of "free-issue" equipment to suppliers by Eskom will in future be discontinued. Switchgear suppliers will be responsible for sourcing the relevant "free-issue" equipment directly from the Eskom contract holders at contracted prices.
- j) provision of a full set of operating tools (including hand-held remote control units, etc.) for each switchboard as detailed in this specification and in accordance with the Eskom switchgear ordering schedule;
- k) ensuring that equipment is in an acceptable and safe condition during all phases of transportation from factory to site and during storage up to the point of official handing over;
- l) provision of OEM accredited installation and pre-commissioning services for all on-site work;
- m) the installation of the complete switchboard on-site - pre-commissioned, tested and ready for handover;
- n) where applicable, the first filling of each gas-filled compartment to the rated value. The switchgear shall be transported with a positive gas pressure as per the manufacturer's recommendation.

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- o) provision of all documentation relevant to the switchgear including routine factory test reports and the on-site testing records;
- p) provision of all specified training in accordance with 240-56065202 by OEM accredited trainers;
- q) if applicable, the issuing of a field service bulletin to the user if the need for modification becomes apparent during the normal lifetime of the equipment. The bulletin shall give the user details of the modification and the reason for it;
- r) delivery of spares to any of the specified destinations. For the duration of the contract, spares will be subject to the same Contract Price Adjustment (CPA) formula as applied to the circuit-breakers; and
- 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 specification(s) and completed schedule A's with the enquiry;
- b) the supply of a fully completed switchgear ordering schedule for each switchboard ordered;
- c) the evaluation of all switchgear offered and documentation supplied with a tender. This includes the compilation of an evaluation report summarising the outcomes of the evaluation;
- d) when required, the assessment and evaluation of the relevant manufacturing facilities;
- e) when required, the assessment and evaluation of the relevant transport, installation and pre-commissioning facilities;
- f) the approval of all drawings submitted by the supplier (e.g. general arrangement, nameplate, schematic wiring, etc.);
- g) the approval of all other documentation provided by the supplier (e.g. manuals, training material, etc.);
- h) where applicable, the supply and delivery to the supplier of the free-issue "on-board" protection and control schemes;

NOTE In order to optimise and streamline manufacturing processes, the logistical arrangements and supply of "free-issue" equipment to suppliers by Eskom will in future be discontinued. Switchgear suppliers will be responsible for sourcing the relevant "free-issue" equipment directly from the Eskom contract holders.


- i) the inspection and factory acceptance of switchgear prior to dispatching from supplier's factory to site for installation;
- j) the supply of all associated civil works for the switch room for housing the circuit-breakers panels (switchboard). Civil works are to be fully completed prior to the delivery of the switchgear to site for installation;
- k) the supply and termination of all external power cabling and surge arresters into the relevant cable compartments;
- l) the supply and installation of external control cabling and wiring to the terminals provided in the LV compartment;
- m) where applicable, the supply and installation of all off-board protection and control schemes remote from the switchgear panel;
- n) if necessary, provide suitable storage facilities where switchboards are to be stored for extended durations prior to installation due to unplanned delays; and
- o) the witnessing and approval of the first complete switchboard installation and pre-commissioning;

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APPENDIX B: MODEL SWITCHGEAR ORDERING SCHEDULE

(informative)

	METAL-ENCLOSED FIXED-PATTERN SWITCHGEAR ORDERING SCHEDULE	Page 1
		Rev 0

Project No:	??
Project Name:	??
Purchase Req No:	??

Schedule A: Purchasers specific site requirements

DSP_34-1702

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Item	Description	Schedule A																																																																																																																																																																																																						
1	Purchasing details Note: Follow these steps : 1. Select the system voltage. 2. Select the switchboard busbar rating. 3. Select the panel description for each panel in sequence. 4. Fill in all required information in items 2, 3 and 4 below . 5. Fill in required information on "Schematic Diagram" sheet for each panel. NOTES: 1. The SAP number and buyers guide drawing will be automatically selected. 2. The switchboard is made up of the panels listed below from left to right (facing the switchboard) <ul style="list-style-type: none">System Voltage kV 22Switchboard busbar rating A 1250																																																																																																																																																																																																							
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P32	N/A	-	-		-																																																																																																																																																																																																			
1.2	<ul style="list-style-type: none">Number of sets of standard operating tools/spares required Number 1																																																																																																																																																																																																							
1.3	<ul style="list-style-type: none">On-board protection and control schemes required Yes/No Yes																																																																																																																																																																																																							
1.4	<ul style="list-style-type: none">Delivery effected not before Date ??																																																																																																																																																																																																							
1.5	<ul style="list-style-type: none">Erection and pre-commissioning completed not later than Date ??																																																																																																																																																																																																							
Note: 1) Details of existing switchboard are shown on the schematic (dashed lines). 2) The default location for protection and control schemes is "on-board" with a HMI in a separate control room.																																																																																																																																																																																																								

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2	Delivery and off-loading on SITE	
2.1	• Switchgear transported by supplier	YES
2.2	• Switchgear transported by supplier and delivered to	??
2.3	• Region	??
2.4	• Site / Warehouse Name	??
2.5	• Nearest Town	??
2.6	• Province	??
2.7	• Distance from nearest town km	??
2.8	• Access to site warehouse	??
2.9	• Off-loaded from transport vehicle and transferred to intended location by supplier	YES
2.10	• Erection, installation and pre-commissioning done by supplier	YES
2.11	• Construction supply available	??
2.12	• Power supply voltage on site - AC Vac	230
2.13	- DC (Substation auxiliary/control voltage) Vdc	??
3	Existing Switchboard Layout (if applicable)	
	• Manufacturer	N/A
	• Type	N/A
	• Date of manufacture	N/A
	• Joggle box required	N/A
	• Existing busbar configuration	N/A
	• Extension to existing switchboard is done on the ...	N/A
4	Special instructions/notes to the supplier: <p>This is a comment section of the schedule. To add information in this section click and type your special comments to the manufacturer / supplier.</p> <p>1) There can be more than one note to the manufacturer in this section</p> <p>If no instruction is required, select this text and then delete.</p>	
SCHEDULE COMPLETED BY (PROJECT ENGINEER):		
Name:	??	Date: ??
Signature:		
Contact Number:	??	

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APPENDIX C: MODEL FACTORY ACCEPTANCE TEST (FAT) CHECKLIST

(informative)

Factory Equipment Acceptance Checklist

The following shall be verified and tested during the factory acceptance testing (FAT).		
Item	Checked (√)	Requirement
1		Verify overall compliance of the switchboard and individual panels with the relevant switchgear ordering schedule
2		Verify provision of earthing facilities in accordance with 0 (this need not necessarily be checked for every switchboard – but must be carried out for the 1 st few switchboards supplied)
3		Verify correct operation of cable and busbar earthing switches and associated interlocks (refer to 0) (this need not necessarily be checked for every switchboard – but must be carried out for the 1 st few switchboards supplied)
4		Verify provision of padlocking facilities in accordance with 5.8 (this need not necessarily be checked for every switchboard – but must be carried out for the 1 st few switchboards supplied)
5		Verify mechanical operation (tripping, disconnecter operation) of circuit-breaker panels (random verification) NOTE Each circuit-breaker mechanical “close” is required to be disabled and therefore cannot be verified.
7		Verify correct operation of hand-held remote control unit for tripping/closing of circuit-breakers (random verification) (refer to 5.9)
8		Verify correct operation of motorised disconnectors (random verification) (refer to 5.10)
9		Verify switchboard physical design aspects for compliance with 5.11.1 (this need not necessarily be checked for every switchboard – but must be carried out for the 1 st few switchboards supplied)
10		Verify switchboard LV compartment for compliance with 5.11.2 (this need not necessarily be checked for every switchboard – but must be carried out for the 1 st few switchboards supplied)
11		Check insulation requirements for compliance with 5.12 (this need not necessarily be checked for every switchboard – but must be carried out for the 1 st few switchboards supplied)
12		Verify all provisions for power cable terminations in panel all cable compartments for compliance with 5.13
13		Verify all provisions for power surge arresters and surge arrester ratings (where applicable) for compliance with 5.14

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Factory Equipment Acceptance Checklist

The following shall be verified and tested during the factory acceptance testing (FAT).

Item	Checked (√)	Requirement
14		Verify provision of cable test facilities for compliance with 5.15.
15		Verify correct operation of status indicators in accordance with 5.16 (this need not necessarily be checked for every switchboard – but must be carried out for the 1 st few switchboards supplied).
16		Verify all labels and colour coding for compliance with 5.16.2.
17		Verify all CTs and VTs and associated wiring for compliance with DSP 34-1996 and D-DT-5408 respectively.
18		Verify all auxiliary and control circuits and associated wiring for compliance to 240-56063705 and D-DT-5408. Refer to also 7.2.1 and 7.2.3 of SANS 62271-1.
19		Verify all nameplates for compliance with 5.22.
20		Verify provision of all tools and tool cabinet in accordance with 5.23.
21		Verify all documentation supplied with switchboard for compliance with 5.24.2.

Factory Acceptance of Factory Capability Checklist

The following shall be verified and tested during the factory acceptance of the factory capability.

Item	Checked (√)	Requirement
1		Design capability
2		Test capability
3		Tools and equipment
4		Procedures for manufacturing
5		Quality compliance

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APPENDIX D: MODEL FORMS OF TECHNICAL SCHEDULES

(Informative)

D.1 General

The purchaser is provided with a model form as a convenient aid to the purchasing process. The form is intended to obviate the need for preparing a detailed technical specification.

The purchaser needs only specify compliance with this specification, provide the tenderers with details of his/her particular requirements, and set out the information he requires the tenderer to provide, as indicated below.

A model form is provided to assist the purchaser in completing a schedule in which the tenderer is required to declare all deviations between his/her offer and this specification.

D.2 Schedules

The model form provides the purchaser with examples of schedule A and schedule B. In his/her enquiry, the purchaser should provide his/her own schedule A and schedule B, based on these examples. The schedules attached in this document must be used as a template when a commercial enquiry is issued.

D.2.1 Schedule A

Schedule A lists the requirements to be specified by the purchaser in enquiries and orders. These requirements may include references to the relevant subsections in this specification, to assist in compiling the schedules.

Where the text of any referenced standard stipulates that the purchaser shall indicate his/her requirements, these requirements should also be specified in schedule A.

The purchaser should set out his/her particular requirements and choices in his/her own schedule A.

D.2.2 Schedule B

The purchaser should draw up his/her own schedule B (based on the schedule B in the model form), and require the tenderer to fill in this schedule. By doing this, the tenderer will state compliance with this specification and provide the information the purchaser has requested.

D.2.3 Deviation Schedule

If a purchaser requires a deviation schedule to be completed, he/she should state this in the enquiry specification.

NOTES

Where this specification 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 standardisation, purchasers are encouraged not to deviate from these preferences.

When preparing his/her own schedule A and schedule B from the examples in the model form, the purchaser need only include those items that he/she considers to be relevant or necessary.

These schedules, when completed, become normative annexes to the enquiry specification.

D.2.3 Switchgear ordering schedule

The switchgear ordering schedule will be provided to the supplier at the time of order placement and used to define the project specific requirements for which the supplier should cater for. It also defines the specific technical requirements for the project.

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A schematic single-line diagram for the switchboard as well as project specific requirements for surge arresters, CTs, size, type and number of cables connected per panel, etc. is provided in the ordering schedule in order for the manufacturer/supplier to assemble and pre-wire the switchgear panels.

D.3 Commercial conditions

The purchaser will need to indicate the commercial conditions applicable and draw up a price schedule. Requirements for delivery, storage, packing and marking should be attended to in this part of the enquiry.

D.4 Testing

Attention should be paid to the subject of testing and the related costs. A certified party should carry out tests and tenderers should be requested to provide assurances on this point. Type tests shall be according to this specification and the type test reports shall not be older than five years (if not previously accepted by Eskom). All the testing shall be carried out with the switchgear wholly assembled in accordance with the relevant IEC standards. Price schedules should be drawn up and covering letters should be worded in such a way that the costs of all services (such as tests, delivery and spares) are declared and allowed for in the tender.

Before type tests and routine tests are carried out on samples, the number of samples used and the frequency of sampling should be agreed upon with the supplier.

D.5 Revision of standards used as normative references

As indicated, this specification is based on a set of defined standards, which may have been revised or amended. Most purchasers would, in principle, wish to employ the latest standards. The recommended approach to this question is to secure an undertaking from a supplier to review the latest versions and amendments and to incorporate these, where possible and agreeable. A blanket commitment to work to the "latest" versions of standards should be carefully assessed since it creates legal difficulties of interpretation and poses risks for both parties. This invariably cannot be done in the time available.

In the event that the tenderer leaves a blank space in schedule B, it shall be assumed that the tender complies with the requirements as listed in schedule A

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APPENDIX E: TECHNICAL SCHEDULES A & B FOR 11 KV, 22 KV AND 33 KV

FIXED PATTERN INDOOR PRIMARY SWITCHGEAR

SAP: _____ Select item from list . . .

Schedule A: Purchasers specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

1	2	3	4	5
Item	Clause of 240- 56065131	Description	Schedule A	Schedule B
1		Item and system description Select item from list . . .		
1.1		<input type="checkbox"/> SAP No	_____	XXXXXXXXXX
1.2		<input type="checkbox"/> Buyers Guide Drawing	_____	XXXXXXXXXX
1.3	5.3	<input type="checkbox"/> Panel application	_____	XXXXXXXXXX
1.4	4.1	<input type="checkbox"/> Nominal system voltage kV	_____	XXXXXXXXXX
1.5		<input type="checkbox"/> System voltage range pu	0,9 to 1,1	XXXXXXXXXX
1.6	5.1.2	<input type="checkbox"/> System earthing (effective/non effective)	Non-effective	XXXXXXXXXX
		<input type="checkbox"/>		
2		Ratings		
2.1	4.1	<input type="checkbox"/> Rated voltage (U_r) kV	_____	
2.2	4.1	<input type="checkbox"/> Number of phases	3	
2.3	4.2	<input type="checkbox"/> Rated short-duration power-frequency withstand voltage (U_d) kV	_____	
2.4	4.2	<input type="checkbox"/> Rated peak lightning impulse withstand voltage (U_p) kV	_____	
2.5	4.3	<input type="checkbox"/> Rated frequency (f_r) Hz	50	
2.6	4.4	<input type="checkbox"/> Rated normal current (I_r) - busbar main circuit A	_____	
2.7	4.4	<input type="checkbox"/> Rated normal current (I_r) - circuit-breaker main circuit A	_____	
2.8	4.5	<input type="checkbox"/> Rated short-time withstand current (I_k and I_{ke}) kA	_____	
2.9	4.6	<input type="checkbox"/> Rated peak withstand current (I_p and I_{pe}) kA	_____	
2.10	4.7	<input type="checkbox"/> Rated duration of short circuit (t_k) - main circuit and earthing switch s	3	
2.11	4.7	<input type="checkbox"/> Rated duration of short circuit (t_{ke}) - earthing circuit s	1	
2.12	4.8	<input type="checkbox"/> Rated d.c. supply voltage of closing and opening devices and of auxiliary and control circuits (U_a) V	110	
2.13	4.8	<input type="checkbox"/> Rated a.c. supply voltage of heaters and other a.c. auxiliary circuits (U_a) V	230	
2.14	4.9	<input type="checkbox"/> Rated supply frequency of closing and opening devices and of auxiliary and control circuits Hz	d.c.	

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2.15	4.9	<input type="checkbox"/> Rated supply frequency of heaters and other a.c. auxiliary circuits	Hz	50	
2.16	4.101	<input type="checkbox"/> Rated short-circuit breaking current (I_{sc}) of circuit-breaker	kA	_____	
2.17	4.102	<input type="checkbox"/> Circuit-breaker class		_____	
2.18	4.102	<input type="checkbox"/> First-pole-to-clear factor (k_{pp}) for circuit-breaker		_____	
2.19	4.102	<input type="checkbox"/> Standard values of TRV related to the rated short-circuit breaking current (SANS 62271-100)		_____	
2.20	4.103	<input type="checkbox"/> Rated short-circuit making current of circuit-breaker and earthing switch	kA	_____	
2.21	4.104	<input type="checkbox"/> Rated operating sequence for circuit-breaker		_____	
2.22	4.104	<input type="checkbox"/> Minimum resting time following rated operating sequence	min	xxxxxxxxxx	
2.23	4.105	<input type="checkbox"/> Characteristics for short-line faults		N/A	
2.24	4.106	<input type="checkbox"/> Rated out-of-phase making and breaking current for circuit-breakers	kA	xxxxxxxxxx	
2.25	4.107	<input type="checkbox"/> Classification of circuit-breaker according to its restrike performance (line- and cable-charging breaking current)		_____	
2.26	4.107	<input type="checkbox"/> Rated capacitive switching currents for circuit-breaker - line-charging breaking current	A	_____	
2.27	4.107	<input type="checkbox"/> Rated capacitive switching currents for circuit-breaker - cable-charging breaking current	A	_____	
2.28	4.107	<input type="checkbox"/> Classification of circuit-breaker according to its restrike performance (capacitor bank breaking current)		_____	
2.29	4.107	<input type="checkbox"/> Rated capacitive switching currents for circuit-breaker - single capacitor bank breaking current	A	_____	
2.30	4.107	<input type="checkbox"/> Rated capacitive switching currents for circuit-breaker - back-to-back capacitor bank breaking current	A	_____	
2.31	4.107	<input type="checkbox"/> Rated capacitive switching currents for circuit-breaker - back-to-back capacitor bank inrush making current	kA	_____	
2.32	4.108	<input type="checkbox"/> Inductive load switching for circuit-breaker		xxxxxxxxxx	
2.33	4.109	<input type="checkbox"/> Rated opening time for circuit-breaker	ms	xxxxxxxxxx	
2.34	4.109	<input type="checkbox"/> Rated break-time for circuit-breaker	ms	xxxxxxxxxx	
2.35	4.109	<input type="checkbox"/> Rated closing time for circuit-breaker	ms	xxxxxxxxxx	
2.36	4.109	<input type="checkbox"/> Rated open-close time for circuit-breaker	ms	xxxxxxxxxx	
2.37	4.109	<input type="checkbox"/> Rated reclosing time for circuit-breaker	ms	xxxxxxxxxx	
2.38	4.109	<input type="checkbox"/> Rated close-open time for circuit-breaker	ms	xxxxxxxxxx	
2.39	4.109	<input type="checkbox"/> Rated pre-insertion time for circuit-breaker	ms	xxxxxxxxxx	
2.40	4.110	<input type="checkbox"/> Circuit-breaker mechanical endurance		_____	

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2.41	4.110	class		
		<input type="checkbox"/> Number of mechanical operations for circuit-breaker	_____	
2.42	4.110	<input type="checkbox"/> Disconnecter mechanical endurance class	Class M1	
2.43	4.110	<input type="checkbox"/> Number of mechanical operations for disconnecter	2000	
2.44	4.111	<input type="checkbox"/> Classification of circuit-breakers as a function of electrical endurance	_____	
		<input type="checkbox"/>		
3	5.1	Service conditions		
3.1	5.1.1	<input type="checkbox"/> Location (indoors/outdoors)	Indoors	
3.1	5.1.1	<input type="checkbox"/> Ambient air temperature range °C	-5 to +40	
3.2	5.1.1	<input type="checkbox"/> Altitude (amsl) m	up to 1800	
3.3	5.1.1	<input type="checkbox"/> Class of pollution (SANS 60815-1:2009)	Medium ('C')	
3.4	5.1.1	<input type="checkbox"/> Average humidity %	up to 95	
3.5	5.1.1	<input type="checkbox"/> Condensation	Yes	
4	5.2	General		
4.1	5.2.1/5.2.2	<input type="checkbox"/> Fixed pattern metal-enclosed switchgear compliant to SANS 62271-200	Yes	
4.2	5.2.3	<input type="checkbox"/> Insulating medium	xxxxxxxxxx	
4.3	5.2.3	<input type="checkbox"/> Maintenance-free period for high-voltage parts years	> 30 years	
4.4		<input type="checkbox"/> Panel manufacturer	xxxxxxxxxx	
4.5		<input type="checkbox"/> Panel country of origin	xxxxxxxxxx	
4.6		<input type="checkbox"/> Panel model/type designation	xxxxxxxxxx	
4.7		<input type="checkbox"/> Panel total mass kg	xxxxxxxxxx	
4.8	5.2.5	<input type="checkbox"/> Circuit-breaker compliant to SANS 62271-100	Yes	
4.9		<input type="checkbox"/> - Circuit-breaker manufacturer	xxxxxxxxxx	
4.10		<input type="checkbox"/> - Circuit-breaker country of origin	xxxxxxxxxx	
4.11		<input type="checkbox"/> - Circuit-breaker model/type designation	xxxxxxxxxx	
4.12	5.2.6	<input type="checkbox"/> - Circuit-breaker pole operation	3-pole operated	
4.13	5.2.6	<input type="checkbox"/> - Stored energy operation for circuit-breaker mechanism	Yes	
4.14	5.2.6	<input type="checkbox"/> - Energy storage device	Spring	
		<input type="checkbox"/> 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		
4.15	5.2.6	<input type="checkbox"/> - Manual and motorised spring charging	Yes	
4.16	5.2.6	<input type="checkbox"/> - Manual and electric energy release	Yes	
4.17	5.2.8	<input type="checkbox"/> - Mechanical TRIP and CLOSE control facility (only TRIP control to be available on the front of the panel)	Yes	
4.18	5.2.9	<input type="checkbox"/> - Circuit-breaker interrupting technology (Vacuum/SF ₆)	Vacuum	

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4.19	5.2.10	<input type="checkbox"/> - Circuit-breaker mechanisms maintenance free in accordance with the electrical and mechanical endurance class	Yes	
4.20	5.2.11	<input type="checkbox"/> Disconnecter compliant to SANS 62271-102	Yes	
4.21	5.2.11	<input type="checkbox"/> Type of disconnector offered (e.g. three/two position)	xxxxxxxxxx	
		<input type="checkbox"/>		
5	5.3	Architecture and accessibility to compartments		
5.1	5.3.1	<input type="checkbox"/> Single / double busbar design	Single	
5.2	5.3	<input type="checkbox"/> Busbar configuration (Horizontal/Vertical/Delta)	xxxxxxxxxx	
5.3	5.3	<input type="checkbox"/> Bus-section/coupler switching device	_____	
	5.3.2 / 5.3.3	<input type="checkbox"/> Separate / segregated compartments required for:		
5.4		<input type="checkbox"/> - circuit-breaker	Yes	
5.5		<input type="checkbox"/> - Busbar / disconnector	Yes	
5.6		<input type="checkbox"/> - Power cable/CT (feeder/incomer panels only)	Yes	
5.7		<input type="checkbox"/> - LV equipment	Yes	
5.8	5.3.4	<input type="checkbox"/> Accessibility to GIS circuit-breaker, busbar/disconnector compartments	Non-accessible	
5.9	5.3.4	<input type="checkbox"/> Accessibility to non-GIS compartments	Tool-based	
5.10	5.3.4	<input type="checkbox"/> Accessibility to cable compartments (where applicable)	Interlock-controlled	
		<input type="checkbox"/>		
6	5.4	Service continuity of the switchgear		
6.1	5.4	<input type="checkbox"/> Loss of service continuity category	LSC2A/LSC2 B	
		<input type="checkbox"/>		
7	5.5	Partition class and shutters		
7.1	5.5	<input type="checkbox"/> Partitioning class	PM	
		<input type="checkbox"/>		
8	5.6	Internal arc classification		
8.1	5.6.1	<input type="checkbox"/> Internal arc classification	AFLR	
8.2	5.6.2	<input type="checkbox"/> Classification test current value kA	_____	
8.3	5.6.2	<input type="checkbox"/> Classification test current duration s	1	
8.4	5.6.3	<input type="checkbox"/> Pressure relief direction	Upwards	
8.5	5.6.5	<input type="checkbox"/> Internal arc absorbers / coolers are Yes/N offered o	xxxxxxxxxx	
8.6	5.6.6	<input type="checkbox"/> Additional ducting required to achieve Yes/N the IAC o	xxxxxxxxxx	
		<input type="checkbox"/>		
9	5.7	Earthing circuit and earthing devices		
9.1	5.7.1	<input type="checkbox"/> Cross section dimensions of the earthing bars (earthing circuit) mm	_____	
9.2	5.7.1	<input type="checkbox"/> M12 fixing holes provided in earthing bars	Yes	
9.3	5.7.2.1	<input type="checkbox"/> Method used for cable earthing (incomer/feeder panels)	circuit-breaker & disconnector /	

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			earthing switch	
9.4	5.7.2.1	<input type="checkbox"/> Cable earthing switch class (min)	Class E1	
9.5	5.7.2.2	<input type="checkbox"/> Method used for busbar earthing	Bus-section circuit-breaker & disconnect / earthing switch	
9.6	5.7.2.2	<input type="checkbox"/> Busbar earthing switch class (min)	Class E1	
9.7	5.7.2.2	<input type="checkbox"/> Panel used for busbar earthing	xxxxxxxxxx	
9.8	5.7.2.3	<input type="checkbox"/> Integral earthing switches compliant to SANS 62271-102 with independent unlatched operation (where applicable)	Yes	
9.9	5.7.2.4	<input type="checkbox"/> Isolation of circuit-breaker trip circuit when in earthing (EARTH) position (where applicable)	Yes	
9.10	5.7.2.5	<input type="checkbox"/> Cable earth interlocking system provided in accordance with 5.7.2.5	Yes	
9.11	5.7.2.6	<input type="checkbox"/> Busbar earth interlocking system provided in accordance with 5.7.2.6	Yes	
9.12	5.7.2.8	<input type="checkbox"/> Positive mechanical interlocking provided in accordance with 5.7.2.8	Yes	
		<input type="checkbox"/>		
10	5.8	Padlocking facilities		
	5.8.1	<input type="checkbox"/> Facilities provided to padlock the following:		
10.1		<input type="checkbox"/> - functional unit in the OFF, ON and EARTH positions;	Yes	
10.2		<input type="checkbox"/> - the mechanical tripping device in the case where the circuit-breaker is used for earthing	Yes	
10.3	5.8.2	<input type="checkbox"/> 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	
10.4	5.8.3	<input type="checkbox"/> Padlocking facility diameter for mm padlock shackle	>6	
		<input type="checkbox"/>		
11	5.9	Stand-off hand-held remote control unit for remote switching of circuit-breakers		
11.1	5.9.1	<input type="checkbox"/> Stand-off hand-held remote control unit supplied with switchboard	Yes	
11.2	5.9.2	<input type="checkbox"/> Minimum length of lead (umbilical cord) m	20	
11.3	5.9.3	<input type="checkbox"/> Control box fitted with push-buttons in accordance with 5.9.3	Yes	
11.4	5.9.4	<input type="checkbox"/> Control box IP rating IP	IP67	
11.5	5.9.5	<input type="checkbox"/> Type of female receptacle (circular panel connector with self-retaining bayonet coupling) to be supplied	ITT CANNON type CA 3102 A 14S-2	

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			(or equiv)	
11.6	5.9.6	<input type="checkbox"/> Location of female receptacle	LV Compartment door - front	
11.7	5.9.7	<input type="checkbox"/> TRIP control function pins	C and D	
11.8	5.9.7	<input type="checkbox"/> CLOSE control function pins	A and B	
11.9	5.9.8	<input type="checkbox"/> Circuit-breaker local mechanical closing facility disabled (when disconnecter CLOSED)	Yes	
		<input type="checkbox"/>		
12	5.10	Motorised disconnectors		
12.1	5.10.1	<input type="checkbox"/> Disconnecter motorised using an integral internal motor	Yes	
12.2	5.10.2	<input type="checkbox"/> Continuous power rating of motorised disconnecter W	≤ 100	
12.3	5.10.2	<input type="checkbox"/> Total operating time s	xxxxxxxxxx	
12.4	5.10.3	<input type="checkbox"/> Motorised disconnecter circuit and wiring requirements	240-56063705 and D-DT- 5408	
12.5	5.10.4	<input type="checkbox"/> Manual operation of disconnecter possible in the event of an emergency	Yes	
		<input type="checkbox"/>		
13	5.11	Switchboard physical design		
13.1	5.11.1.2	<input type="checkbox"/> Switchroom and cable trench design	D-DT-5238	
13.2	5.11.1.3	<input type="checkbox"/> Operation of switchgear	Front	
13.3	5.11.1.4	<input type="checkbox"/> Panel fronts fully aligned	Yes	
13.4	5.11.1.5	<input type="checkbox"/> Customised steel support frame/base provided for switchboard in accordance with 5.11.1.5	Yes	
13.5	5.11.1.6	<input type="checkbox"/> Access to cable compartment and trench (rear / front)	xxxxxxxxxx	
13.6	5.11.1.7	<input type="checkbox"/> Removable custom-fitted non-slip steel trench cover plates provided in accordance with 5.11.1.7	xxxxxxxxxx	
13.7	5.11.1.8	<input type="checkbox"/> Provision for bolting the steel support frame/base to the concrete floor in accordance with 5.11.1.8	xxxxxxxxxx	
13.8	5.11.1.9	<input type="checkbox"/> Suitable for future extensions on both sides of the switchboard	Yes	
		<input type="checkbox"/> Overall panel dimensions		
13.9	5.11.1.10	<input type="checkbox"/> - Width mm	xxxxxxxxxx	
13.10	5.11.1.10	<input type="checkbox"/> - Depth (front to rear) mm	xxxxxxxxxx	
13.11	5.11.1.10	<input type="checkbox"/> - Height mm	xxxxxxxxxx	
13.12	5.11.1.10	<input type="checkbox"/> - rear of panel to centre of LV control cable gland plate mm	xxxxxxxxxx	
13.13	5.11.1.10	<input type="checkbox"/> - minimum distance required above switchgear to switch room ceiling (d _C) mm	xxxxxxxxxx	
13.14	5.11.1.10	<input type="checkbox"/> - distance (clearance) required to the rear switch room wall (min) mm	xxxxxxxxxx	
13.15	5.11.1.10	<input type="checkbox"/> - cable trench width required (min) mm	xxxxxxxxxx	

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13.16	5.11.1.10	<input type="checkbox"/> - cable trench over-hang required for cable terminations (min)	mm	xxxxxxxxxx	
13.17	5.11.1.11	<input type="checkbox"/> All doors equipped with travel stops		Yes	
13.18	5.11.1.12	<input type="checkbox"/> Lifting eyes provided in accordance with 5.11.1.12		Yes	
	5.11.2	<input type="checkbox"/> LV Compartment			
13.19	5.11.2.1	<input type="checkbox"/> Location of LV compartment		Front	
13.20	5.11.2.2	<input type="checkbox"/> Top entry removable brass/aluminium LV gland plates provided with holes and knock-outs/grommets		Yes	
13.21	5.11.2.3	<input type="checkbox"/> Positioning of terminal strips in accordance with 5.11.2.3		_____	
13.22	5.11.2.4	<input type="checkbox"/> Protection and control scheme location		_____	
	5.11.3	<input type="checkbox"/> Degrees of protection of enclosures			
13.23		<input type="checkbox"/> - Moving parts	IP	IP2X	
13.24		<input type="checkbox"/> - Live parts	IP	IP3X	
13.25		<input type="checkbox"/> - cable boxes	IP	IP3X	
13.26		<input type="checkbox"/> - gas-filled compartments (where applicable)	IP	IP65	
	5.11.4	<input type="checkbox"/> Busbars			
13.27	5.11.4.1	<input type="checkbox"/> - details regarding procedure to be followed to remove and replace faulty panel provided with tender documentation		Yes	
13.28	5.11.4.2	<input type="checkbox"/> - solid-dielectric busbar systems fully screened (where applicable)		Yes	
	5.11.5	<input type="checkbox"/> Corrosion protection of exposed metal parts			
13.29	5.11.4.1	<input type="checkbox"/> - Detailed specification number for exposed sheet metal (DSP 34-1658)	DS	xxxxxxxxxx	
13.30	5.11.4.2	<input type="checkbox"/> - Corrosion protection system applied for all exposed joints and tees in earthing busbars and busbar connections		xxxxxxxxxx	
13.31	5.11.4.3	<input type="checkbox"/> - Corrosion protection system applied for all exposed bolts, nuts and washers		xxxxxxxxxx	
13.32	5.11.4.4	<input type="checkbox"/> - Corrosion protection system applied for all earthing bars		Tinned / Silverised	
		<input type="checkbox"/>			
14	5.12	Insulation requirements			
	5.12.1	<input type="checkbox"/> Bushings and insulators			
14.1	5.12.1.1	<input type="checkbox"/> - Bushings for cable connections in accordance with NRS 012		Yes	
14.2	5.12.1.2	<input type="checkbox"/> - Bushings and insulators partial discharge tested to SANS 60270		Yes	
	5.12.2	<input type="checkbox"/> Requirements for gas-filled compartments (where applicable)			
14.3	5.12.2.1	<input type="checkbox"/> - Gas-filled compartments factory gas-filled and tested with new gas at rated filling pressure		Yes	
14.4	5.12.2.2	<input type="checkbox"/> - period to replenishment of the gas	years	> 30	
14.5	5.12.2.2	<input type="checkbox"/> - maximum gas leakage rate per year	%	xxxxxxxxxx	

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14.6	5.12.2.2	<input type="checkbox"/> - quantity of gas required for busbar compartment	kg	xxxxxxxxxx	
14.7	5.12.2.2	<input type="checkbox"/> - quantity of gas required for circuit-breaker compartment	kg	xxxxxxxxxx	
14.8	5.12.2.3 & 5.12.2.4	<input type="checkbox"/> - SF6 gas in accordance with IEC 60376 and certificate provided		Yes	
14.9	5.12.2.5	<input type="checkbox"/> - gas filling/evacuation point provided for each gas-filled compartment		DILO DN8	
14.10	5.12.2.5	<input type="checkbox"/> - gas filling/evacuation point and gas pressure gauge separated		Yes	
14.11	5.12.2.5	<input type="checkbox"/> - gauge responding to gas density and indicating pressure compensated for temperature provided for each gas-filled compartment		Yes	
14.12	5.12.2.5	<input type="checkbox"/> - type of gauge offered		xxxxxxxxxx	
14.13	5.12.2.5	<input type="checkbox"/> - gas density monitoring device (density switch) provided for each gas-filled compartment with contacts in accordance with 240-56063705		Yes	
14.14	5.12.2.5	<input type="checkbox"/> - Electrical interlocks and alarms provided by the gas density monitoring device in accordance with 240-56063705		Yes	
14.15	5.12.2.5	<input type="checkbox"/> - non-return valves fitted on all DN8 fittings		Yes	
14.16	5.12.2.8	<input type="checkbox"/> - service offered to recover and replenish SF6 gas after switchgear service life		Yes	
		<input type="checkbox"/>			
15	5.13	Provisions for power cable terminations (where applicable)			
15.1	5.13.1	<input type="checkbox"/> Type of cable terminations to NRS 012		Type 4 / Type 5	
15.2	5.13.2	<input type="checkbox"/> Cable compartment design and construction to NRS 012		Yes	
15.3	5.13.3	<input type="checkbox"/> Number of individual bushings provided per phase (excluding surge arresters - where applicable)		_____	
15.4	5.13.4	<input type="checkbox"/> Number and type of cables to be terminated		_____	
15.5	5.13.5/ 5.13.6	<input type="checkbox"/> Number of individual cable support clamps (D-DT-8019) per cable per phase		_____	
15.6	5.13.5/ 5.13.6	<input type="checkbox"/> - range of cable support clamp (cable diameter)	mm	_____	
15.7	5.13.7	<input type="checkbox"/> Clearance distance from the cable support clamp to the terminal fixing centre line	mm	_____	
15.8	5.13.8	<input type="checkbox"/> Vermin proofing plate thickness offered (min) - if applicable	mm	xxxxxxxxxx	
15.9	5.13.8	<input type="checkbox"/> Vermin proofing plate material offered - if applicable		xxxxxxxxxx	
15.10	5.13.9	<input type="checkbox"/> Copper earthing bar provided in cable compartment in accordance with 5.13.9		Yes	

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		<input type="checkbox"/>		
16	5.14	Provisions of surge arresters (where applicable)		
16.1		<input type="checkbox"/> Surge arresters to be supplied with switchgear	No	xxxxxxxxxx
		<input type="checkbox"/>		
17	5.15	Cable test facilities		
17.1	5.15.1	<input type="checkbox"/> Type of cable test facility offered	Integral / via cable termination	
17.2	5.15.2	<input type="checkbox"/> Cable test facility mechanically interlock with earthing switch	Yes	
17.3	5.15.3	<input type="checkbox"/> Test plugs offered	xxxxxxxxxx	
		<input type="checkbox"/>		
18	5.16	Position / status indication		
18.1	5.16.1.1	<input type="checkbox"/> Mimic indicating the ON, OFF and EARTH positions of the main circuit provided	Yes	
18.2	5.16.1.2	<input type="checkbox"/> - mimic located on front of panel	Yes	
18.3	5.16.1.2	<input type="checkbox"/> - type of mimic offered	Mechanical / electrical	
18.4	5.16.1.2	<input type="checkbox"/> - "lamp/display check" push-button function provided	Yes	
18.5	5.16.1.3	<input type="checkbox"/> Definite mechanical position / status indications coupled directly to operating mechanism / drive shaft provided for:	Yes	
18.6	5.16.1.3	<input type="checkbox"/> - circuit-breaker contact status (open/closed)	Yes	
18.7	5.16.1.3	<input type="checkbox"/> - disconnect status (open/closed/earthing – as and where applicable)	Yes	
18.8	5.16.1.3	<input type="checkbox"/> - earthing status (open/earthed)	Yes	
	5.16.1.4	<input type="checkbox"/> Switching device mechanical position indication		
18.9		<input type="checkbox"/> - Closed position: "I" in white lettering on a red background	Yes	
18.10		<input type="checkbox"/> - Open position: "O" in white lettering on a green background	Yes	
18.11		<input type="checkbox"/> - Earthed position: (the earth symbol) in black on a yellow background	Yes	
18.12	5.16.1.6	<input type="checkbox"/> Circuit-breaker closing status indicated by "SPRING CHARGED" and "SPRING DISCHARGED"	Yes	
18.13	5.16.1.7	<input type="checkbox"/> Type of non-resettable circuit-breaker operation counter offered	Mechanical / electrical	
18.14	5.16.1.8	<input type="checkbox"/> Position / status indicators visible from in front of the switchgear panel with the doors closed	Yes	
18.15	5.16.2	<input type="checkbox"/> Cable live indication provided	SANS 61243-5	
18.16	5.16.3	<input type="checkbox"/> Gas density gauges provided for each gas-filled compartment (where applicable)	Yes	
		<input type="checkbox"/>		

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19	5.17	Labels and colour coding		
19.1	5.17.1.2	<input type="checkbox"/> Labels manufactured to DSP 34-1513 and D-DT-5049 (unless otherwise specified or agreed)	Yes	
19.2	5.17.1.3/4	<input type="checkbox"/> Method of attachment of labels	xxxxxxxxxx	
	5.17.2	<input type="checkbox"/> Warning labels		
19.3	5.17.2.1	<input type="checkbox"/> - "NO STEP" on top of panels	Yes	
19.4	5.17.2.2	<input type="checkbox"/> - Busbar blanking plates labelled "BUSBAR - DO NOT REMOVE" on ends of switchboard	Yes	
	5.17.3	<input type="checkbox"/> Main circuit and switchboard designation labels		
19.5	5.17.3.3/4	<input type="checkbox"/> - Labels provided for all panels and busbar sections	Yes	
19.6		<input type="checkbox"/> - Width (min.) mm	> 300	
19.7		<input type="checkbox"/> - Height (min.) mm	> 50	
19.8	5.17.3.3	<input type="checkbox"/> - Main circuit designation label positions	Front and rear of panels (not on removable doors/covers)	
19.9	5.17.3.5	<input type="checkbox"/> - Label provided for switchboard	Yes	
19.10		<input type="checkbox"/> - Width (min.) mm	> 400	
19.11		<input type="checkbox"/> - Height (min.) mm	> 50	
19.12	5.17.3.5	<input type="checkbox"/> - Switchboard designation label position	Front (not on removable doors)	
	5.17.4	<input type="checkbox"/> Operating labels		
19.13	5.17.4.1	<input type="checkbox"/> - Instructions for mechanically tripping and closing the circuit-breaker	Yes	
19.14	5.17.4.1	<input type="checkbox"/> - Instructions for charging circuit-breaker closing spring	Yes	
19.15	5.17.4.1	<input type="checkbox"/> - Instructions for earthing the cable and busbar (as applicable)	Yes	
19.16	5.17.4.2	<input type="checkbox"/> - Actuator(s) for local opening and closing of the circuit-breaker	Yes	
19.17	5.17.4.3	<input type="checkbox"/> - Stand-off remote control unit push buttons	Yes	
19.18	5.17.4.4	<input type="checkbox"/> - Switchgear tool cabinet	Yes	
19.19	5.17.4.5	<input type="checkbox"/> - Cable test facilities		
	5.17.5	<input type="checkbox"/> Function labels		
19.20	5.17.5.1	<input type="checkbox"/> - Function labels provided to identify all LV equipment	Yes	
19.21	5.17.5.2	<input type="checkbox"/> - Function label text height (min) mm	> 5	
	5.17.6	<input type="checkbox"/> Panel colour coding		
19.22	5.17.6.1	<input type="checkbox"/> - LV compartment door		
19.23	5.17.6.2	<input type="checkbox"/> - Tool cabinet	Light grey	
		<input type="checkbox"/>		
20	5.18	Current Transformers (see D-DT-5408) (where applicable)		
20.1	5.18.1	<input type="checkbox"/> Dry type current transformers to SANS 60044-1	Yes	
20.2	5.18.1	<input type="checkbox"/> Make (manufacturer) of CT offered	xxxxxxxxxx	
20.3	5.18.1	<input type="checkbox"/> Type of CT offered	xxxxxxxxxx	
20.4	5.18.2	<input type="checkbox"/> CT specification (drawing number)	D-DT-5408	

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20.5	5.18.10	<input type="checkbox"/> Rated short-time withstand current	kA		
20.6	5.18.2	<input type="checkbox"/> Position relative to the circuit-breaker		Cable side	
20.7	5.18.3	<input type="checkbox"/> Terminal numbering		D-DT-5408	
		<input type="checkbox"/> Protection current transformers:			
20.8	5.18.2	<input type="checkbox"/> a) cores		CORE 1	
20.9	5.18.2	<input type="checkbox"/> b) class		PX	
20.10	5.18.2	<input type="checkbox"/> c) ratios	A		
		<input type="checkbox"/> Measurement current transformers:			
20.11	5.18.2	<input type="checkbox"/> a) cores		CORES 2 & 3	
20.12	5.18.2	<input type="checkbox"/> b) class			
		<input type="checkbox"/> NOTE Measurement cores to be dual rated on specified ratios			
20.13	5.18.2	<input type="checkbox"/> c) burden	VA		
20.14	5.18.2	<input type="checkbox"/> d) ratios	A		
20.15	5.18.6	<input type="checkbox"/> Location of CTs		xxxxxxxxxx	
20.15	5.18.7	<input type="checkbox"/> Block type CTs fully screened (if applicable)		Yes	
		<input type="checkbox"/>			
21	5.19	Voltage Transformers (see D-DT-5408) (where applicable)			
21.1	5.19.1	<input type="checkbox"/> Busbar connected dry-type VTs provided for each bus-section		Yes	
21.2	5.19.2	<input type="checkbox"/> Dry type voltage transformers to SANS 60044-2		Yes	
21.3	5.19.2	<input type="checkbox"/> Make (manufacturer) of VT offered		xxxxxxxxxx	
21.4	5.19.3	<input type="checkbox"/> VTs fully insulated and screened		Yes	
21.5	5.19.4	<input type="checkbox"/> VTs of the plug-in type		Yes	
21.6	5.19.5	<input type="checkbox"/> Protection provided to prevent ferro- resonance		Yes	
21.7	5.19.6	<input type="checkbox"/> Means provided to disconnect VT from busbar		Yes	
21.8	5.19.7	<input type="checkbox"/> VT specification (drawing number)		D-DT-5408	
		<input type="checkbox"/> Voltage transformer specification:			
21.9	5.19.7	<input type="checkbox"/> a) ratio		$V_{nom}/\sqrt{3}$ kV / 110/ $\sqrt{3}$ V	
21.10	5.19.7	<input type="checkbox"/> b) class		3P/0,2	
21.11	5.19.7	<input type="checkbox"/> c) burden	VA	25	
21.12	5.19.7	<input type="checkbox"/> d) voltage factor		1,2 continuous / 1,9 for 30 s	
21.13	5.19.7	<input type="checkbox"/> e) short-circuit impedance	<input type="checkbox"/> Sec	xxxxxxxxxx	
21.14	5.19.8	<input type="checkbox"/> Terminal numbering		D-DT-5408	
		<input type="checkbox"/>			
22	5.20	Auxiliary and control circuits (see 240-56063705 / D-DT-5408)			
22.1	5.20.1	<input type="checkbox"/> Auxiliary and control circuits to 240- 56063705 and D-DT-5408		Yes	
		<input type="checkbox"/> Auxiliary power supplies:			
22.2		<input type="checkbox"/> - Provision		On site by Eskom	

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22.3	<input type="checkbox"/>	- Peak power requirement/panel (max)	VA	xxxxxxxxxx	
22.4	<input type="checkbox"/>	- Standby power requirements/panel	VA	xxxxxxxxxx	
	<input type="checkbox"/>	Circuit-breaker spring-charging motor control circuit:			
22.5	<input type="checkbox"/>	- d.c. supply voltage range of operation	%	85 to 110	
22.6	<input type="checkbox"/>	- d.c. power (peak)	W	≤ 1000	
22.7	<input type="checkbox"/>	- d.c. power (continuous)	W	≤ 100	
22.8	<input type="checkbox"/>	- total time taken to charge spring	s	≤ 10	
22.9	<input type="checkbox"/>	- method offered for protection against continual motor running (over-run)		xxxxxxxxxx	
22.10	<input type="checkbox"/>	- automatic charging of closing spring		Yes	
22.11	<input type="checkbox"/>	- number of spare contacts of SLS provided		D-DT-5408	
	<input type="checkbox"/>	Motorised disconnecter circuit:			
22.12	<input type="checkbox"/>	- d.c. supply voltage range of operation	%	85 to 110	
22.13	<input type="checkbox"/>	- d.c. power (peak)	W	xxxxxxxxxx	
22.14	<input type="checkbox"/>	- d.c. power (continuous)	W	≤ 100	
22.15	<input type="checkbox"/>	- total time taken to operate disconnecter	s	xxxxxxxxxx	
22.16	<input type="checkbox"/>	- method offered for protection against continual motor running (over-run)		xxxxxxxxxx	
	<input type="checkbox"/>	Circuit-breaker closing control circuit:			
22.17	<input type="checkbox"/>	- d.c. supply voltage range of operation	%	85 to 110	
22.18	<input type="checkbox"/>	- d.c. power (peak)	W	≤ 500	
22.19	<input type="checkbox"/>	- number of close coils required		1	
22.20	<input type="checkbox"/>	- close coil current	A	xxxxxxxxxx	
22.21	<input type="checkbox"/>	- close coil resistance @ 20°C	Ω	xxxxxxxxxx	
	<input type="checkbox"/>	Circuit-breaker tripping control circuit:			
22.22	<input type="checkbox"/>	- d.c. supply voltage range of operation	%	70 to 110	
22.23	<input type="checkbox"/>	- d.c. power (peak)	W	≤ 500	
22.24	<input type="checkbox"/>	- number of trip coils required		2	
22.25	<input type="checkbox"/>	- physically and electrically separate trip control circuits		Yes	
22.26	<input type="checkbox"/>	- trip circuit supervision		Yes	
22.27	<input type="checkbox"/>	- trip coils rated to carry 20mA d.c. continuously		Yes	
22.28	<input type="checkbox"/>	- trip coil current	A	xxxxxxxxxx	
22.29	<input type="checkbox"/>	- trip coil resistance @ 20°C	Ω	xxxxxxxxxx	
22.30	<input type="checkbox"/>	Circuit-breaker equipped with anti-pumping circuitry		Yes	
22.31	<input type="checkbox"/>	Circuit-breaker control circuit interlocks provided in accordance with DST 34-1692		Yes	
22.32	<input type="checkbox"/>	Alarm circuits provided and wired in accordance with DST 34-1692 and D-DT-5408		Yes	
	<input type="checkbox"/>	Auxiliary contacts provided (spare for Eskom use):			
	<input type="checkbox"/>	Duty rating			
22.33	<input type="checkbox"/>	- a.c. and d.c. supply current	A	10	

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22.34	<input type="checkbox"/> - N/O and N/C contact reference positions	Circuit-breaker opened, spring discharged, busbar and cable earthing switches not applied, disconnect in closed position	
22.35	<input type="checkbox"/> Low gas alarm contacts		
22.36	<input type="checkbox"/> - N/O	0	
	<input type="checkbox"/> - N/C	2	
22.37	<input type="checkbox"/> Low gas block contacts		
22.38	<input type="checkbox"/> - N/O	0	
	<input type="checkbox"/> - N/C	2	
22.39	<input type="checkbox"/> Circuit-breaker auxiliary switch contacts		
22.40	<input type="checkbox"/> - N/O	4	
	<input type="checkbox"/> - N/C	4	
22.41	<input type="checkbox"/> Circuit-breaker spring limit switch contacts		
22.42	<input type="checkbox"/> - N/O	2	
	<input type="checkbox"/> - N/C	2	
22.43	<input type="checkbox"/> Cable earthed (incomer/feeder panels only)		
22.44	<input type="checkbox"/> - N/O	1	
	<input type="checkbox"/> - N/C	0	
22.45	<input type="checkbox"/> Busbar earthed status indication (incomer panels only)		
22.46	<input type="checkbox"/> - N/O	=====	
	<input type="checkbox"/> - N/C	=====	
22.47	<input type="checkbox"/> Disconnect open position		
	<input type="checkbox"/> - N/O	1	
22.48	<input type="checkbox"/> Disconnect closed position		
	<input type="checkbox"/> - N/C	1	
22.49	<input type="checkbox"/> Terminal blocks and terminal strips:		
22.50	<input type="checkbox"/> - Number of spare terminals provided	≥ 6	
	<input type="checkbox"/> - Terminal blocks to DSP 34-253, screw clamp, spring-loaded insertion type	Yes	
22.51	<input type="checkbox"/> - Terminal block width offered mm	≥ 8	
22.52	<input type="checkbox"/> - Make of terminal block offered	xxxxxxxxxx	
22.53	<input type="checkbox"/> Lugs (insulated hook blade type)	Crimped	
22.54	<input type="checkbox"/> Earth sliding link types/equivalents	Weidmuller TVP SAKA 10	
22.55	<input type="checkbox"/> Trunking provided at top and bottom of each terminal rail	Yes	
22.56	<input type="checkbox"/> 'Fine-tooth' trunking tooth width mm	6,1	
22.57	<input type="checkbox"/> Trunking size mm	60 x 60	
22.58	<input type="checkbox"/> Wiring size:		
	<input type="checkbox"/> - CT, VT and motor control circuit wires mm ²	2,5	

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22.59		<input type="checkbox"/> - Control and other auxiliary wires	mm ²	1,5	
22.60		<input type="checkbox"/> - Minimum number of strands		7	
22.61		<input type="checkbox"/> Wiring colour:		red/white/blue /black	
		<input type="checkbox"/> - CT and VT wires			
22.62		<input type="checkbox"/> - Earth wires		green/yellow	
22.63		<input type="checkbox"/> - All other wires		grey	
22.64		<input type="checkbox"/> Wiring identification		Ferruling	
22.65		<input type="checkbox"/> Terminal strips in accordance with table 1 of 240-56063705 - located in LV compartment		Yes	
22.66		<input type="checkbox"/> LV MCBs:		Yes	
		<input type="checkbox"/> - MCBs to SANS 60947-2 and IEC 60898			
22.67		<input type="checkbox"/> - Make and type offered		xxxxxxxxxxx	
22.68		<input type="checkbox"/> - I _{CU}	kA	xxxxxxxxxxx	
22.69		<input type="checkbox"/> - I _{CS}	kA	xxxxxxxxxxx	
22.70		<input type="checkbox"/> - Utilisation category (SANS 60947-2)		'A'	
22.71		<input type="checkbox"/> - Max service voltage	V	xxxxxxxxxxx	
22.72		<input type="checkbox"/> - d.c. MCB rated voltage	V	≥ 125	
22.73		<input type="checkbox"/> - Pollution degree (SANS 60947-2)		≥ 3	
22.74		<input type="checkbox"/> - Suitable for isolation (SANS 60947- 2)		Yes	
22.75		<input type="checkbox"/> - Protection curve (SANS 60947-2 / IEC 60898)		'C'	
22.76		<input type="checkbox"/> - Location		LV compartment	
22.77		<input type="checkbox"/> LV Fuses		Yes	
22.78		<input type="checkbox"/> - LV fuses to SANS 60269-2		G	
22.79		<input type="checkbox"/> - LV fuse system offered (SANS 60269-2)		E1	
22.80		<input type="checkbox"/> - Utilisation category		gG	
22.81		<input type="checkbox"/> - Make and type offered		xxxxxxxxxxx	
		<input type="checkbox"/>			
23	5.21	Arc detection protection system equipment			
23.1	5.21.1	<input type="checkbox"/> Internal arc detection protection scheme required		No	
		<input type="checkbox"/>			
24	5.22	Nameplates			
		<input type="checkbox"/> Nameplates provided for the following:		Yes	
24.1	5.22.1	<input type="checkbox"/> - switchgear panel (IEC 62271-200)		Yes	
24.2	5.22.3	<input type="checkbox"/> - CT (IEC 60044-1) - where applicable		Yes	
24.3	5.22.3	<input type="checkbox"/> - VT (IEC 60044-2) - where applicable		Yes	
24.4	5.22.5/6	<input type="checkbox"/> Duplicate nameplates provided in LV compartment for CTs and VT - where applicable		Yes	
24.5	5.22.8	<input type="checkbox"/> Nameplate material offered		xxxxxxxxxxx	
		<input type="checkbox"/>			
25	5.23 / 8.3	Tools and spares			
		<input type="checkbox"/> Tools to be supplied with switchboard (minimum			

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25.1	5.23.1	<input type="checkbox"/> requirements): - full set of operating tools (provide list on separate sheet provided)	Sets	1 set per switchboard	
25.2	5.23.2	<input type="checkbox"/> - hand-held remote control unit	EA	1 per switchboard	
25.3	5.23.3	<input type="checkbox"/> - wall-mounted steel tool cabinet	EA	1 per switchboard	
25.4	5.23.9	<input type="checkbox"/> Standard tools available for minor maintenance (provide list on separate sheet provided)		Yes	
25.5	5.23.10	<input type="checkbox"/> Specialised tools available for major maintenance purposes (provide list on separate sheet provided)		Yes	
25.6	5.23.11 / 8.3	<input type="checkbox"/> Spares available for maintenance (provide list on separate sheet provided)		Yes	
25.7	5.23.12 / 8.3	<input type="checkbox"/> Spares to be supplied with switchboard (where applicable) <input type="checkbox"/> Trip coils & close coils	Sets	2 of each per switchboard	
26	5.24	Documentation Note: All tender documentation to be provided in electronic format.			
26.1	5.24.1	<input type="checkbox"/> Documentation to be supplied with tender: <input type="checkbox"/> - GA drawing per panel type (provide drawing number on separate sheet provided)	Sets	1	
26.2		<input type="checkbox"/> - Generic layout of nameplates (provide drawing number on separate sheet provided)	Sets	1	
26.3		<input type="checkbox"/> - Generic auxiliary and control circuit schematic wiring diagrams for each panel type	Sets	1	
26.4		<input type="checkbox"/> - list of all operating tools for each type of switchgear panel offered (provide list on separate sheet provided)	Sets	1	
26.5		<input type="checkbox"/> - list of all standard minor maintenance tools for each kiosk circuit-breaker offered (provide list on separate sheet provided)	Sets	1	
26.6		<input type="checkbox"/> - list of all specialised major maintenance tools for each kiosk circuit-breaker offered (provide list on separate sheet provided)	Sets	1	
26.7		<input type="checkbox"/> - full list of spares required for maintenance (provide list on separate sheet provided)	Sets	1	
26.8		<input type="checkbox"/> - full list as well as copies of type test certificates and reports (provide report numbers on separate sheet provided)	Sets	1	
26.9		<input type="checkbox"/> - generic routine test certificates for each panel type	Sets	1	
26.10		<input type="checkbox"/> - transport, storage, installation, operating and maintenance manuals	Sets	1	

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26.11	5.24.2	<input type="checkbox"/> - training material	Sets	1	
26.12		<input type="checkbox"/> - all other relevant additional information requested	Sets	1	
		<input type="checkbox"/> Documentation to be supplied with each switchboard:			
26.13		<input type="checkbox"/> - Schematic wiring diagram for each panel type	Sets	1	
26.14		<input type="checkbox"/> - Complete set of routine test certificates for each panel	Sets	1	
26.15		<input type="checkbox"/> - Commissioning and hand-over test sheet	Sets	1	
26.16		<input type="checkbox"/> - Transport, storage, installation, operating and maintenance manuals	Sets	1	
26.17		<input type="checkbox"/> Units used in Republic of South Africa		In tender/offer	
26.18		<input type="checkbox"/> Project reference list, service to Eskom		In tender/offer	
		<input type="checkbox"/>			
27	5.25	Miscellaneous			
		<input type="checkbox"/> General			
27.1		<input type="checkbox"/> Guarantee period	Years	xxxxxxxxxx	
27.2		<input type="checkbox"/> Required period for spares availability	Years	25 years after discontinuation of switchgear	
27.3		<input type="checkbox"/> Packaging in accordance with 240-56065131	Y/N	Yes	
28	10	Training Requirements			
28.1		<input type="checkbox"/> Training offered in accordance with 240-56065202	Y/N	Yes	

SIGNATURES

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

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Any deviations offered to this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviation will at least be more cost-effective than that specified by Eskom.

[illegible]

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