 Eskom	Standard	Technology
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Title **SPECIFICATION FOR 11 KV TO 33KV WITHDRAWABLE PATTERN AIR-INSULATED INDOOR PRIMARY SWITCHGEAR STANDARD** Unique Identifier: **240-56065131**

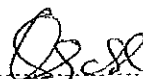
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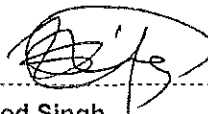
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DBOUS Acceptance


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Date: **20/4/17**

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

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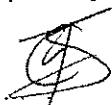
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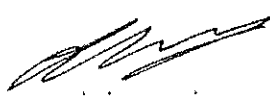


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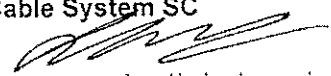


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1 INTRODUCTION

The Distribution Division's specific requirements for indoor air-insulated primary switchgear of the withdrawable 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 shall be included in the project schedules.

Certain specifications are referenced in the normative references section. Suppliers shall be responsible for obtaining copies of NRS documents and any other national and international standards referred to. Copies of the latest revision of Eskom documents will be supplied by the purchaser and will form part of the enquiry documentation.

Keywords

Switchgear, metal-enclosed, metal-clad, indoor, circuit-breaker, switchboard, primary switchgear, withdrawable switchgear

2 SUPPORTING CLAUSES

2.1 SCOPE

This specification provides the Distribution Division's specific and standardised requirements for indoor air-insulated metal-enclosed primary switchgear of the withdrawable pattern in accordance with SANS 62271-200. The switchgear is intended for use in Distribution substations and switching stations having nominal operating voltages of 11 kV, 22 kV and 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 are also included in schedule A. For any tender requirements an excel format of all technical schedules for the different panel options will be made available for completion.

2.1.1 Purpose

None

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this specification shall apply the most recent edition of the documents listed below.

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

2.2.1 Normative

[1] ISO 9001 Quality Management Systems

IEC standards

[2] IEC 60071-1, Insulation co-ordination – Part 1. Definitions, principles and rules

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- [3] IEC 60073, Basic and safety principles for man-machine interface, marking and identification – Coding principles for indicators and actuators
- [4] IEC 60112, Method for the determination of the proof and the comparative tracking indices of solid insulating materials
- [5] IEC 60297-1, Dimensions of mechanical structures of the 482,6mm (19 inch) series – Part 1 Panels and racks
- [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

South African national standards

- [8] SANS 60044-1, Current Transformers.
- [9] SANS 60044-2, Voltage Transformers
- [10] SANS 60270, Partial discharge measurements
- [11] SANS 60282-1, High-voltage fuses – Part 1: Current-limiting fuses.
- [12] SANS 60529, Degrees of protection provided by enclosures (IP code)
- [13] SANS 60815-1:2009, Selection and dimensioning of high-voltage insulators intended for use in polluted conditions – Part 1 Definitions, information and general principles.
- [14] SANS 61243-5, Live working – Voltage detectors – Part 5: Voltage detecting systems (VDS).
- [15] SANS 62271-1, High-voltage switchgear and control gear - Part 1: Common specifications
- [16] SANS 62271-100, High-voltage switchgear and control gear - Part 100 High voltage alternating-current circuit-breakers.
- [17] SANS 62271-102, High-voltage switchgear and control gear - Part 102 High-voltage alternating current disconnectors and earthing switches
- [18] 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
- [19] SANS 62271-202, High-voltage switchgear and controlgear Part 202. High-voltage/low-voltage prefabricated substation
- [20] SANS 1019, Standard voltages, currents and insulation levels for electricity supply
- [21] SANS 1091, National colour standards for paint.
- [22] SANS 4521, Metallic coatings – Electrodeposited silver and silver alloy coatings for engineering purposes
- [23] 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
- [24] SANS 876 (NRS 012), 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

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South African NRS standards

None

Eskom standards

- [25] DSP 34-253, Distribution Standard Part 15: Distribution specification for electrical terminal blocks
- [26] DSP 34-306, Distribution Standard Part 7. Specification for a distribution busbar arc detection protection scheme for indoor metal clad switchboards
- [27] 240-56030659, Station class, metal-oxide surge arresters without spark-gaps standard
- [28] 240-56062515, Labels on control panels, relay panels and other indoor and outdoor equipment standard
- [29] 240-56030619, Accessories for medium-voltage power cables for systems with nominal voltages of 11kV to 33kV standard
- [30] DSP 34-1658, 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
- [33] DST 34-1439 (DISASAANO), Standard for the labelling of high voltage equipment
- [34] 240-56063705 Requirements for the wiring of indoor switchgear from 11kV up to and including 33kV 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-6215, Surge arrester station class 22 kV polymer - outdoor
- [41] D-DT-6216, Surge arrester station class 11 kV polymer - outdoor
- [42] D-DT-8010, Surge arrester distribution class 11 kV and 22 kV polymer – indoor.
- [43] D-DT-8019, Clamp, cable polypropylene
- [44] D-DT-8027, Grommet, cable rubber.

2.2.2 Informative

- [1] None

2.3 DEFINITIONS

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

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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
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)	work performed with the objective of repairing or replacing parts which are found to be out of tolerance by inspection, test, examination, or as required by manufacturer's maintenance manual, in order to restore the component and/or the switchgear and controlgear to an acceptable condition (within tolerance). NOTES 1 This is the definition of "overhaul" given in 3.1.11 of SANS 62271-1. 2 Major maintenance involves the execution of specialised maintenance where specialised knowledge and skills are required and is also sometimes referred to as specialised maintenance
Minor maintenance	the execution of scheduled or preventive maintenance work in accordance with the manufacturer's maintenance manual and requiring the switchgear and controlgear to be taken out of service (i.e. in a down state) NOTES 1 Observations resulting from minor maintenance can lead to the decision to carry out an overhaul 2 Scheduled maintenance is defined in 3.1.7 of SANS 62271-1 3 Minor maintenance may be time-based and/or condition-based. 4 Minor maintenance may also include circuit-breaker examination (refer to 3.1.10 of SANS 62271-1) with diagnostic tests (refer to 3.1.9 of SANS 62271-1) 5 Minor maintenance may also be referred to as 2nd line maintenance
Panel	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
Remote (off-board) control gear	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.
Routine inspection	visual investigation of the principal features of the switchgear and controlgear in service without dismantling. NOTES 1 This inspection is generally directed toward pressures and/or levels of fluids, tightness, position of relays, pollution of insulating parts, but actions such as lubricating, cleaning, washing, etc. which can be

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Definition	Description
	<p>carried out with the switchgear and controlgear in service are also included</p> <p>2 Observations resulting from inspection can lead to the decision to carry out an overhaul</p> <p>3. As indicated in note 1 above, routine inspection may include scheduled maintenance activities in accordance with the manufacturer's maintenance manual</p> <p>4 Routine inspection may also be referred to as 1st line maintenance.</p> <p>5 This is the definition of "inspection" given in 3 1 8 of SANS 62271-1</p>
Specialised tools	any purpose-built tools that are necessary to carry out major (or specialised) maintenance on a circuit-breaker and its components
Stand-off remote control unit	(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 circuit-breakers or racking in/out of circuit-breaker/VT/CPAT
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)
CPAT	Control Power Auxiliary transformer (for auxiliary a.c. power supply to switching stations)
CT	Current transformer
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

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3 SPECIFICATION FOR 11 KV TO 33 KV WITHDRAWABLE PATTERN AIR-INSULATED INDOOR PRIMARY SWITCHGEAR STANDARD RATINGS

4 RATINGS

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

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 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	Common value
11	12	28	95
22	24	50	125 ²⁾
33	36	70	170 ²⁾

NOTES

- The information in this table is extracted from SANS 62271-1, SANS 1019 and IEC 60071-1.
- For 24 kV and 33kV 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. The use of air-insulated switchgear of a higher rated voltage (i.e. to meet the lightning impulse withstand voltage insulation level in accordance with "List 3" of SANS 1019) is not considered to be practical from a physical and financial perspective. Special attention is paid to the application of surge protection devices (i.e. surge arresters) when connecting 24 kV and 33 kV rated switchgear to overhead lines. 24 kV rated switchgear having a 145 kV (or higher) and 33 kV rated switchgear having a 195 kV (or higher) lightning impulse withstand voltage insulation level in accordance with IEC 60071-1 shall be given preference.
- In this table, the withstand voltage applies at the standardised reference atmosphere (temperature, pressure and humidity) specified in IEC 60071-1.
- Due to the fact that the equipment may be installed at altitudes of up to 1800 m AMSL (Above Mean Sea Level) as well as in areas having a high degree of exposure to lightning overvoltages, the lightning impulse withstand voltage insulation levels specified are selected to account for altitude correction above 1000 m AMSL – in accordance with Eskom's insulation co-ordination philosophy and SANS 1019 (List 3 insulation levels). Therefore no further altitude correction factors need be applied in accordance with SANS 62271-1 for equipment installed up to 1800 m AMSL.

4.3 RATED FREQUENCY (F_R)

The rated frequency shall be 50 Hz.

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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 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 A or 2000 A. The rated normal current of the busbar offered shall be stated in schedule B.

4.4.4 The rated normal current of all feeder panel main circuits shall be 630 A, 800 A or 1250 A. The rated normal current of the feeder panel 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	630/800/ 1250	2000	2000	630/800/ 1250	2500	2500	630/800/1 250
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 and circuit-breakers) 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 and circuit-breakers) 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.

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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 and circuit-breakers) 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

Table 3 – Rated short-time and peak withstand currents

Nominal system voltage U_n [kV]	Rated short-time withstand current I_k, I_{ke} [kA (r.m.s.)]	Rated peak withstand current I_p, I_{pe} [kA (peak)]
11	25	62,5
11	31,5	78,75
22	20	50
22	31,5	78,75
33	20	50

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 racking devices and of auxiliary and control circuits shall be 110 V.

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

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

4.9.1 The rated supply frequency of closing and opening devices, motorised racking devices and of auxiliary and control circuits shall be 50 Hz (d.c.)

4.9.2 The rated supply frequency of heaters and other 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

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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.

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

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 trip-close-trip before the closing spring needs to be charged again

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- 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- and cable-charging current switching shall be stated in schedule B

4.107.2 The rated line- 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

The number of mechanical operations of circuit-breakers 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. The circuit-breaker class offered shall be stated in schedule B.

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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.

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

Circuit-breaker application ³⁾	Circuit-breaker class		Electrical endurance	Re-strike performance during capacitive current breaking (line- and cable-charging)	Mechanical endurance
	Rated voltage				
	12 kV	24 kV and 36 kV			
Incomer	S1 ⁴⁾	S2 ⁵⁾	E2 ¹⁾	C1	M1
Bus-section	S1 ⁴⁾	S2 ⁵⁾	E2 ¹⁾	C1	M1
Feeder	S1 ⁴⁾	S2 ⁵⁾	E2 ²⁾	C1 ⁶⁾	M2
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					
6 Class C2 circuit-breakers will also be considered for acceptance during technical evaluations					

5 DESIGN AND CONSTRUCTION

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

- 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

- d) due to the switchgear being installed in certain regions with frequent occurrence of warm humid winds, sudden changes of temperature may occur resulting in condensation even indoors

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

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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 air-insulated and of the withdrawable pattern design.

5.2.3 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

5.2.4 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 A magnetic actuator mechanism may be accepted

5.2.5 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

5.2.6 Circuit-breakers shall be provided with a mechanical TRIP and CLOSE control facility. Only the OPEN control facility shall be available on the front of the circuit-breaker compartment door

5.2.7 The interrupting medium of circuit-breakers shall be vacuum. Embedded pole vacuum technology is preferred. The type of interrupting technology offered shall be stated in schedule B

NOTES

- 1 Vacuum interrupting technology is preferred for the following reasons: environmentally friendly (SF₆ free) technology, maintenance-free interrupting technology, fully recyclable at end of life
- 2 The embedded pole or resin encapsulated vacuum circuit-breaker technology, where the vacuum interrupter is embedded in an epoxy resin housing with a buffering layer between the ceramic interrupter and epoxy resin housing, is preferred due to the enhanced long-term electrical insulation, environmental resistance and mechanical protection offered over the life-cycle of the circuit-breaker

5.2.8 Circuit-breakers shall be designed for minimal maintenance in accordance with the electrical and mechanical endurance class as specified in Table 4.

5.3 ARCHITECTURE AND ACCESSIBILITY TO COMPARTMENTS

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

5.3.1.1 "incomer" panels incorporating a withdrawable three-pole operated circuit-breaker, cable earthing switch and cable compartment fitted with CTs,

5.3.1.2 "feeder" panels incorporating a withdrawable three-pole operated circuit-breaker, cable earthing switch and cable compartment fitted with CTs,

5.3.1.3 "bus-section" panels incorporating a withdrawable three-pole operated circuit-breaker and CT,

5.3.1.4 "VT" panels incorporating a withdrawable VT and busbar earthing switch, and

5.3.1.5 "CPAT" panels incorporating a withdrawable control (auxiliary) power transformer.

5.3.2 Incomer and feeder panels shall have the following defined compartments.

5.3.2.1 "circuit-breaker" compartment with front access for housing the withdrawable three-pole operated circuit-breaker,

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5.3.2.2 "*busbar*" compartment,

5.3.2.3 "*cable*" compartment with rear access for housing the power cable terminations and 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 defined compartments

5.3.3.1 "*circuit-breaker*" compartment with front access for housing the withdrawable three-pole operated circuit-breaker,

5.3.3.2 "*busbar*" compartment, and

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

5.3.4 VT and CPAT panels shall have the following defined compartments:

5.3.4.1 "*VT*" or "*CPAT*" compartment with front access for housing the withdrawable VT or CPAT respectively,

5.3.4.2 "*busbar*" compartment, and

5.3.4.3 "*LV*" compartment with front access for housing the auxiliary and control circuit terminal strips and equipment

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

5.3.5.1 circuit-breaker, VT and CPAT compartments: interlock-controlled accessible compartment; and

5.3.5.2 busbar and cable compartments: tool-based accessible compartment

5.3.6 Where additional access to the cable compartment is provided via a door located in the front of the panel, accessibility to the cable compartment via this door shall be interlock-controlled in accordance with SANS 62271-200

5.4 SERVICE CONTINUITY OF THE SWITCHGEAR

The loss of service continuity category shall be "LSC2B" in accordance with SANS 62271-200.

5.5 PARTITION CLASS AND SHUTTERS

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

5.5.2 Orifice shutter operation shall be positively driven in both directions. Solely gravity operated shutters shall not be accepted

5.5.3 Orifice shutters shall be automatically operated by the movement of the withdrawable part

5.6 INTERNAL ARC CLASSIFICATION

5.6.1 The internal arc classification 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 (i.e. towards the rear)

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 the purposes of carrying out any maintenance activities. Pressure relief flaps shall be clearly identified in accordance with 5.17.2.4.

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5.6.5 Where additional ducting or internal arc pressure relief / absorption is required, it shall be specified in schedule B. Any ducting system for internal arc pressure relief / absorption shall be a type tested design.

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 11 kV 25 kA rated switchgear, the 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 22 kV and 33kV 20 kA rated switchgear, the minimum earthing bar cross section shall be a 25 x 4 mm – providing a minimum cross section area of 100 mm². The cross section dimensions of the earthing bars offered shall be stated in schedule B.

5.7.1.4 For 11 kV and 22 kV 31.5 kA 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.

5.7.1.5 The 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 Each incomer and feeder panel shall be fitted with a cable earthing switch of minimum class E1 in accordance with SANS 62271-102. Alternatively, the withdrawable circuit-breaker may be used as the cable earthing switch.

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5.7.2.2 Earthing of the busbar shall be by means of a busbar earthing switch of minimum class E1 in accordance with SANS 62271-102. Alternatively, one of the withdrawable circuit-breakers may be used as the busbar earthing switch. The VT panel shall be used for busbar earthing. The VT panel and circuit-breaker (where applicable) that is used for earthing the busbar shall be identified with proper labelling.

NOTE Due to the risk of theft / removal from the switch room, separate dedicated earthing trucks/carnages are no longer accepted

5.7.2.3 Earthing switches in accordance with SANS 62271-102 shall be of the integral type having independent manual operation (i.e. independent unlatched operation where the origin of the energy is manual)

5.7.2.4 Where a withdrawable circuit-breaker is used for earthing, the electrical tripping circuit of a circuit-breaker shall be isolated when the circuit-breaker is in the earthing position.

5.7.2.5 A cable earth interlocking system shall be provided to ensure that operation of the cable earthing switch is prevented unless the associated circuit-breaker is only in the disconnected, removed or test position. The interlocking device shall prevent the circuit-breaker from being racked into the service position when the associated cable earthing switch is closed. In addition, the interlocking system shall use a contact from the cable live indication system to prevent the cable earth being applied to a live cable. The interlocking system shall be fail safe and therefore shall not be reliant on the presence of an auxiliary a.c. or d.c. voltage supply to ensure that the above conditions are met. 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 racking in of the busbar earthing circuit-breaker shall be prevented unless all circuit-breakers (including the relevant bus-section circuit-breaker(s)) are only in the disconnected, removed or test positions. Where busbar live indication is provided, this shall be used as an additional measure to prevent earthing of a live busbar. The interlocking system shall eliminate the possibility of racking in any of the circuit-breakers to the service position while the busbar earth is applied. The interlocking system shall be fail safe and therefore shall not be reliant on the presence of an auxiliary a.c. or d.c. voltage supply to ensure that the above conditions are met. 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:

- a) open and rack out all bus-section circuit-breakers connected to the busbar section to be earthed
- b) open and rack out all incomer and feeder circuit-breakers on the switchgear panels connected to the busbar section to be earthed
- c) earth the busbar section by either.
 - closing the busbar earthing switch in the VT panel associated with that section, or
 - racking in and closing the designated circuit-breaker in the VT panel associated with that section

NOTE Where a withdrawable 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 Each circuit-breaker, VT and CPAT shall be fitted with an earthing terminal to facilitate testing of earth continuity between the withdrawable parts and the switchgear main earthing bar. The earthing terminals shall be easily accessible from the front of the device and shall be labelled in accordance with 5.16.3.1 c)

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5.8 PADLOCKING FACILITIES

5.8.1 Facilities shall be provided to padlock the following:

- a) all orifice shutters individually in the closed position;
- b) the circuit-breaker in each of the service, test/disconnected and, where applicable, earthing positions;
- c) where applicable, integral earthing switches in both the open and earthing positions, and
- d) in the case where the circuit-breaker is used for earthing, the mechanical tripping device

5.8.2 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

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.

5.9.8 The circuit-breaker mechanical CLOSE button on the circuit-breaker compartment door 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 from the protection and control scheme or the stand-off remote control unit.

5.10 RACKING OPERATION AND MOTORISED RACKING DEVICES FOR WITHDRAWABLE PARTS

5.10.1 The interlocking device for circuit-breaker, VT and CPAT compartments doors shall be such that transfer of withdrawable parts (i.e. circuit-breaker, VT or CPAT) to and from the service position shall only be possible when the compartment door is closed.

5.10.2 The interlock system for circuit-breaker, VT and CPAT compartments doors shall prevent the withdrawal or engagement of the withdrawable part when the door is open.

5.10.3 Each switchgear panel shall be supplied fitted with an integral internal motorised racking device capable of racking the withdrawable part (i.e. circuit-breaker, VT and CPAT – as applicable) from the service position to the

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test position and vice versa. Alternatively, an externally mounted / located motorised racking device shall be provided for each switchboard. This device shall be used to rack the breaker from the service position to the test position and back to the service position without over winding the racking mechanism. The type of motorised racking device offered shall be stated in schedule B.

5.10.4 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 racking time (i.e. time taken to rack-in or rack-out the withdrawable part) shall be stated in schedule B.

5.10.5 The motorised racking device shall comply with and be wired in accordance with 240-56063705 and D-DT-5408.

5.10.6 The manufacturer shall demonstrate the successful operation of this racking device to the same criteria as required by the mechanical operation test of SANS 62271-200 (6.102.1).

5.10.7 The motorised racking device shall be operated from the stand-off remote control unit or via a remote switch wired to the terminals provided for in the LV compartment in accordance with 240-56063705 and D-DT-5408.

5.10.8 The same stand-off remote control unit used for remote switching shall be used for the operation of the motorised racking device. The female receptacle shall be suitable for a self-retaining plug-in connector and matching female receptacle in accordance with the make and type specified in schedule A. The wiring of the pins shall be as specified in schedule A.

5.10.9 The female receptacle for the plug-in connector for remote control of the motorised racking device shall be located on the front LV compartment door.

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

5.10.11 The rack-in button of the stand-off remote control unit shall be the one used for circuit-breaker closing and the rack-out button shall be the one used for circuit-breaker tripping.

5.10.12 The circuit breaker shall only be rackable in the open position. Sufficient interlocking shall be provided to ensure the circuit breaker in closed position cannot be racked in.

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 supplier's 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 Access to the cable compartment shall be from the rear of the switchgear.

NOTE: An additional door providing access to the cable compartment may be provided at the front of the switchgear provided that it meets the requirements of 5.3.6.

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

5.11.1.7 The maximum width of the 11 kV 25 kA and 22 kV 20 kA switchgear panels shall be as follows:
800 A / 1250 A circuit-breaker incomer and feeder panels: 800 mm;

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2500 A circuit-breaker incomer panels: 1000 mm;

1250 A bus-section panels: 1600 mm;

2500 A bus-section panels: 1800 mm, and

VT and CPAT panels: 800 mm.

For the 11 kV and 22 kV 31.5 kA and 33kV 20 kA rated panels the dimensions / distances shall be stated in schedule B as per clause 5.11.1.8.

NOTE Preference shall be given to suppliers who are able to offer panels having widths significantly smaller than the maximum dimensions specified due to the economic savings associated with smaller building requirements

5.11.1.8 The following dimensions / distances shall be stated in schedule B.

the switchgear panel width (i.e. left to right);

the switchgear panel depth (i.e. front to rear);

the switchgear panel overall height (i.e. highest point to bottom);

the horizontal distance from the rear of the panel to the centre of the LV control cable gland plate provided in the LV compartment;

the minimum distance (clearance) required from the internal arc pressure relief flaps to the switch room ceiling;

the minimum distance (clearance) required in front of the switchgear panel for the purposes of removing the withdrawable circuit-breaker, VT or CPAT;

the minimum distance (clearance) required to the rear switch room wall;

the minimum cable trench width required; and

the minimum cable trench over-hang required for cable terminations.

5.11.1.9 The panels shall be designed so as to mechanically prevent a circuit-breaker unit from being accidentally interchanged with another circuit breaker unit having different switching capabilities (i.e. having different ratings or circuit-breaker classes)

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

5.11.1.11 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 and bottom left and right hand sides of the LV compartment for the top or bottom 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

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- 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)

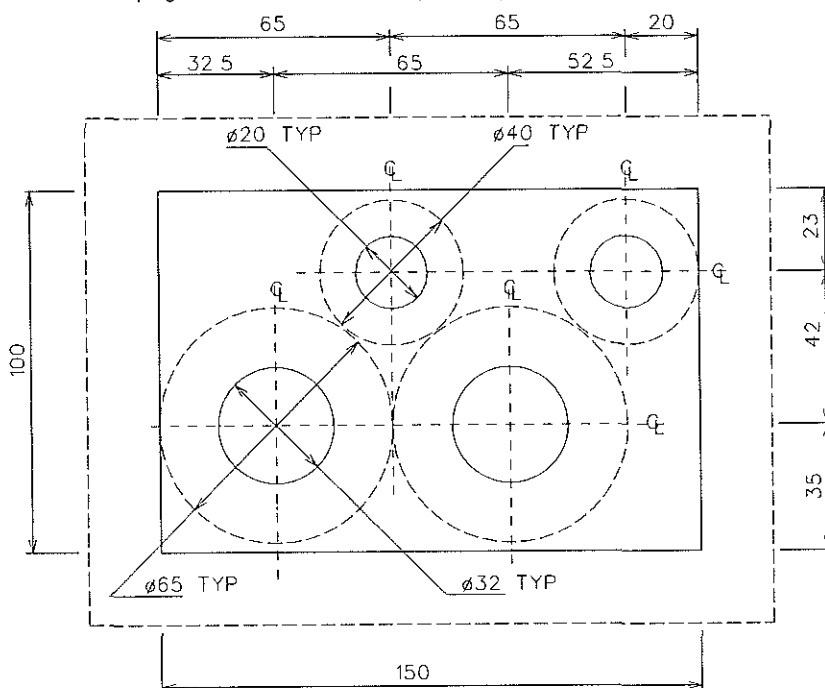


Figure 1 – LV control cable gland plate layout

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; and
- c) IP3X for cable boxes

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

5.11.4 Corrosion protection of metal enclosures and busbars

5.11.4.1 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

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5.11.4.2 All joints and tees in 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.

5.11.4.3 All 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.

5.11.4.4 If specified in schedule A, all copper parts shall be tinned or silverised in accordance with SANS 4521 using the coating classification Cu/Ag (0,95).

5.11.5 Transporting device for removable parts

5.11.5.1 Removable parts (i.e. circuit-breakers, VTs, CPATs) shall be removable on a transporting device with wheels.

5.11.5.2 The transporting device shall be either a separate external device (e.g. circuit-breaker trolley with wheels as required for the "mid-mount", "cassette" type panel designs) type or the integral floor racking type (e.g. circuit-breaker with its own carriage / truck with its own integrated wheels for racking in and out on the floor). The type of transporting device offered shall be stated in schedule B.

NOTES

- 1 The "mid-mount" panel design, where the "cassette" type circuit-breaker compartment is located in the middle of the panel and requires an external trolley to remove circuit-breaker from the panel, is preferred due to the eliminated risk of misalignment of contacts during the racking in of the circuit-breaker. In this case the circuit-breaker is positioned and supported on internal racking tracks located inside the circuit-breaker compartment in order for it to be racked from the disconnected/test position into the service position and vice versa.
- 2 The safe and reliable racking in of circuit-breakers having integral transporting devices that rack in on the floor surface is highly dependant on the floor surface quality. Refer to 5.11.5.4 and 5.11.5.5 for special requirements that are applicable for circuit-breakers having transporting devices that are of the integral floor racking type.
- 3 Where circuit breaker trolley devices are required, the amount of trolleys required need to be specified during the purchase order confirmation.
- 4 Preference will be given to the separate external device type transporting devices (e.g. circuit-breaker trolley with wheels as required for the "mid-mount", "cassette" type panel designs).

5.11.5.3 Where external transporting devices are provided for removable parts, they shall be provided with facilities that allow for height adjustment and alignment with the removable part and the removable part shall be positively latched in position on the transporting device.

5.11.5.4 In the case of switchgear having transporting devices (for removable parts) that are of the integral type (i.e. truck type), the supplier shall provide and install galvanized steel or 3CR12 racking floor plates of minimum thickness 3 mm that shall be secured to the floor in front of the switchgear. These plates shall be designed for the transporting device (carriage) to be withdrawn onto so as to prevent damage to the concrete floor surface. The design details of the racking plates shall be supplied with the tender documentation (refer to 5.24.1). The material offered for the racking floor plates shall be stated in schedule B.

5.11.5.5 In the case of switchgear having transporting devices (for removable parts) that are of the integral type, the supplier shall provide a permanent fixture (uni-struts / frame / support) that shall be cast into the control room floor to allow for proper levelling of the panels during installation. The specific installation requirements and material shall be provided to the civil contractor. This is to ensure that the withdrawable equipment (e.g. circuit-breakers, VTs, etc.) can be properly removed and reinstalled in the panel without misalignment. The details of such uni-struts / frame / support shall be provided with the tender documentation (refer to 5.24.1). Where applicable, the common spacing (i.e. front to rear) between panel fixing centres (e.g. required spacing between parallel uni-struts) and the material offered shall be stated in schedule B.

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5.12 INSULATION REQUIREMENTS FOR LIVE CONDUCTORS IN AIR

5.12.1 Insulation and clearance requirements

5.12.1.1 Internal insulation and clearances in air shall comply with the requirements for live conductors in accordance with SANS 876 (NRS 012) – unless otherwise proven by dielectric and partial discharge type testing to the required insulation levels

NOTE In general, this type of air-insulated switchgear is designed for either type 1 (bare) or type 2 (shrouded/covered) live conductor arrangements in accordance with SANS 876 (NRS 012)

5.12.1.2 Where applicable, shrouding/covering of any medium voltage live equipment (e.g. internal busbars or live connections) shall be made using suitable busbar insulating materials (e.g. heat-shrink tubes / tapes or pre-moulded clip-on covers) having non-static properties and shall be subject to approval by Eskom. The use of "putty and tape" to insulate any live equipment is not acceptable. The type of material offered shall be stated in schedule B.

5.12.1.3 Where insulating materials are used (excluding inorganic insulating materials such as glass or ceramics which do not track) where there is a possibility of leakage current flow and/or surface discharge activity on a creepage or insulating material surface, the insulating material shall have a comparative tracking index (CTI) of at least 400 in accordance with IEC 60112. Alternatively, insulator materials shall be subjected to a tracking and erosion resistance test in accordance with IEC 60587. The classification of the material in accordance with IEC 60587 shall be stated in schedule B. Results of the tracking and erosion test shall be made available to Eskom upon request.

NOTE The CTI values refer to the values obtained in accordance with IEC 60112, method A, for the insulating material used.

5.12.1.4 No LV insulation tape shall be used for insulation of busbar connections or busbar phase identification.

5.12.1.5 Where the switchgear design incorporates the installation of non-metallic phase-to-phase and phase-to-earth segregation material (non-metallic flash-barriers), these materials shall be of a non-static type. Flash-barriers shall be designed so as to prevent any collection of dust, moisture or vermin nesting over time. Metallic brackets / supports used to hold the flash-barriers in position shall not compromise any electrical clearances in air. The material offered shall be stated in schedule B.

NOTE Where non-metallic flash-barriers are used to increase the required flash-over distance in order to comply with the rated peak lightning impulse withstand voltage, consideration must be given to the fact that minimum phase-to-phase and phase-to-earth clearances are still required in order to prevent partial discharge activity under power frequency conditions. Refer to SANS 876 (NRS 012).

5.12.1.6 Where applicable, methods of covering any main power connection shall allow for easy removal for inspection and maintenance.

5.12.1.7 All main circuit insulation and non-metallic segregation materials shall have an expected life exceeding that of the switchgear – without degrading due to age or temperature (as defined in 5.1).

5.12.1.8 The insulation material shall not contribute to any partial discharge activity in the switchboard and shall be identical to the material used in the type testing for insulation testing (impulse, power frequency type testing and temperature rise type testing).

5.12.1.9 No flexible conductors or jumpers shall be used for any medium voltage connections.

5.12.2 Creepage distances

The minimum unified specific creepage distance (USCD) for medium voltage live equipment (insulators, bushings, CTs, VTs, etc.) in air shall be 34,7 mm/kV (as applicable for "medium" pollution class in accordance with SANS 60815-1 2009). The actual minimum creepage distance offered shall be stated in schedule B.

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NOTES

- 1 The reference to specific creepage distance (SCD) was changed in the recent edition of the IEC 60815 standard
- 2 The internal insulation unified specific creepage distance (USCD) specified corresponds to a previous specific creepage distance (SCD) of 20 mm/kV
- 3 The USCD requirement for 34,7 mm/kV is aligned with SANS 62271-202 clause 2.2.2 for exposed insulation where airborne salt or industrial pollution introduced inside the enclosure will not be washed off by rain

5.12.3 Bushings and insulators

5.12.3.1 Where withdrawable parts are connected to busbars, this shall be via bushing type connections to ensure that there is no pressure release during an internal arc from the circuit breaker compartment to the busbar compartment and cable compartment.

5.12.3.2 Bushings and insulators shall comply with the requirements for SANS 876 (NRS 012).

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

5.12.4 Bus-section segregation

The design of the switchboard shall be such that the bus-section panel shall split the switchboard into two completely segregated sections by providing busbar segregation to ensure that if a fault occurs on one side of the bus section panel it will prevent the fault from spreading / travelling to the other side. The method offered to achieve bus-section segregation shall be stated in schedule B.

NOTE Switchboard designs offering segregation (partitioning) between adjacent panel busbar compartments are preferred as damage to adjacent panels is limited in the event of an internal arc in one of the panels.

5.13 PROVISIONS FOR POWER CABLE TERMINATIONS IN CABLE COMPARTMENTS

5.13.1 Cable compartments shall be suitable for type 2 terminations (shrouded) in accordance with NRS 012 – as shown in Figure 2.

NOTE Irrespective of whether the design of the entire cable compartment (i.e. with its CTs, busbars and cable terminal fixing points/flags) is based on a type 1 (bare metal) or type 2 (shrouded) arrangement of live conductors and terminations within air-filled enclosures in accordance with SANS 876 (NRS 012), all power cable terminations and thus their associated terminal fixing points will be shrouded (as a standard) to provide a type 2 termination in accordance with SANS 876 (NRS 012).

5.13.2 Cable compartment design and construction (i.e. distances from cable support clamps to terminal fixing points, phase to phase and phase to earth clearances, insulation, etc.) shall comply with the requirements of SANS 876 (NRS 012).

NOTE When determining phase to phase and phase to earth clearances in air, consideration must be given to the fact that torque shear connector lugs will be used to terminate power cables. It can be assumed that the diameter of the barrel of a torque shear connector lug is 60 mm.

5.13.3 All switchgear incomer and feeder panels shall be supplied with the number of individual terminal fixing points (i.e. individual busbar flags) specified in column 3 of Table 5. Irrespective of the number of cables indicated in the switchgear ordering schedule, the number of separate terminal fixing points (busbar flags) provided shall be in accordance with column 3 of Table 5.

NOTES

- 1 The arrangement is intended to allow for the fitting of a straight shroud over the lug and fasteners as shown in Figure 2 and will be applied irrespective of whether the copper busbar flag is shrouded or bare.
- 2 The only variance in the design of the cable termination enclosure will be based on i) whether surge arresters are specified for the feeder panels or not (refer to 5.14) and ii) whether spare terminal fixing points need to be pre-shrouded (refer to 5.13.7 below).
- 3 Back-to-back lugs onto busbar flags are not acceptable.

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 cable terminal fixing points (busbar flags) per phase	Number, type and size of cables [mm ²]
630	Feeder	2 ¹⁾	2 x 1-core ≤ 300 mm ² Cu for 11 kV ≤ 185 mm ² Cu for 22 kV
800	Feeder	2 ¹⁾	2 x 1-core ≤ 300 mm ² Cu for 11 kV ≤ 185 mm ² Cu for 22 kV
1250	Incomer OR Feeder	2 ^{1),2)}	2 x 1-core / phase ≤ 630 mm ² Cu 1-core
2000 or 2500	Incomer	4	4 x 1-core / phase ≤ 630 mm ² Cu 1-core
<p>NOTES</p> <p>1 Where surge arresters are specified (refer to 5.14), additional separate terminal fixing points (busbar flags) are required for the surge arresters</p> <p>2 The provisions for cable terminations for the 1250 A feeder panels are the same as for the 1250 A incomer panels (i.e. for 2 x 1-core cables per phase) – except that surge arresters may be required for the feeder panel when specified</p> <p>3 Although the actual number of cables to be terminated for a particular project will be indicated in the switchgear ordering schedule, the switchgear panels will always make provision (i.e. by providing individual busbar flags) for the number of cables indicated in this table</p>			

5.13.5 The individual terminal fixing points (busbar flags) for each cable termination shall be in accordance with Figure 2 and shall be suitable for the termination of cables using torque shear connector lugs having an M16 fixing hole

5.13.6 Each busbar flag hole shall be fitted with a M16 stainless steel or brass set screw, washer, spring washer and nut. The length of the set screws provided shall be suitable for fastening a lug with a maximum palm thickness of 20 mm. A distance of 50 mm shall be provided from the fixing centre hole to the busbar flag insulation – as shown in Figure 2. The busbar insulation shall extend for a minimum of 20 mm onto the busbar flag

NOTES

- 1 The recommended set screw length is 50 mm for 800 A panels and 60 mm for 1250 and 2500 A panels
- 2 The 50 mm distance from the fixing centre to the busbar flag insulation is required in order to provide sufficient contact area for the lug palm onto the copper busbar flag
- 3 The insulation is required to extend over the busbar flag for at least 20 mm to allow enough space to shrink the cable termination shroud over the busbar insulation

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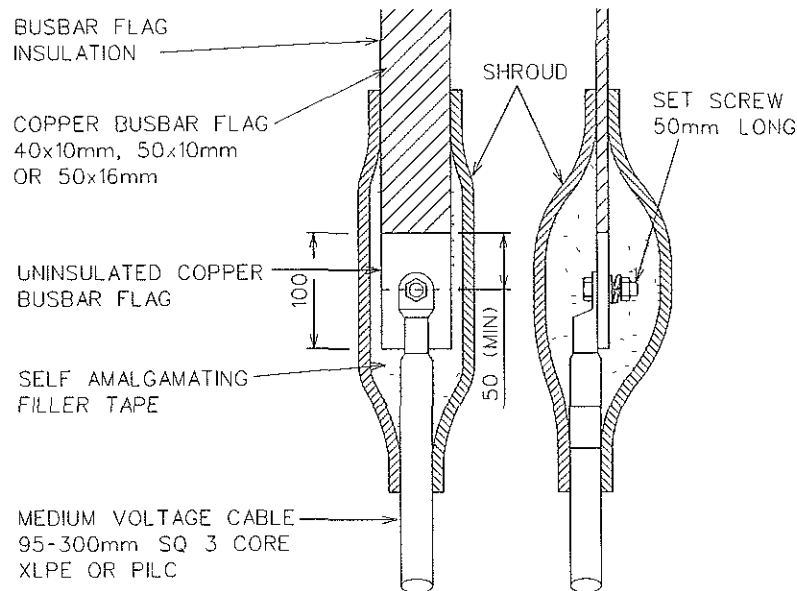


Figure 2a – Terminal fixing point (busbar flag) and shrouded cable termination for 3-core cable

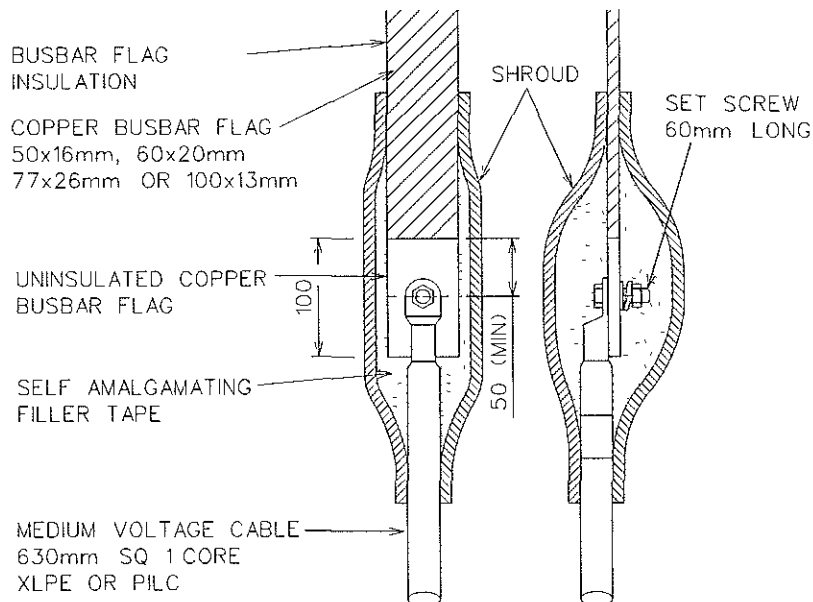


Figure 3b – Terminal fixing point (busbar flag) and shrouded cable termination for 1-core cable

5.13.7 Unless the specified switchgear insulation levels can be achieved within the cable compartment with bare live conductors in air (i.e. type 1 live conductors in accordance with NRS 012), all copper busbar flags that are not required (based on the number of cables to be terminated as indicated in the particular switchgear ordering schedule) shall be shrouded by the supplier as shown in Figure 3. In this case the inner attachment busbar flags shall be used for the cable connection and the outer busbar flags (i.e. closest to the rear of the panel) shall be shrouded to allow for the termination of additional cables at a later stage.

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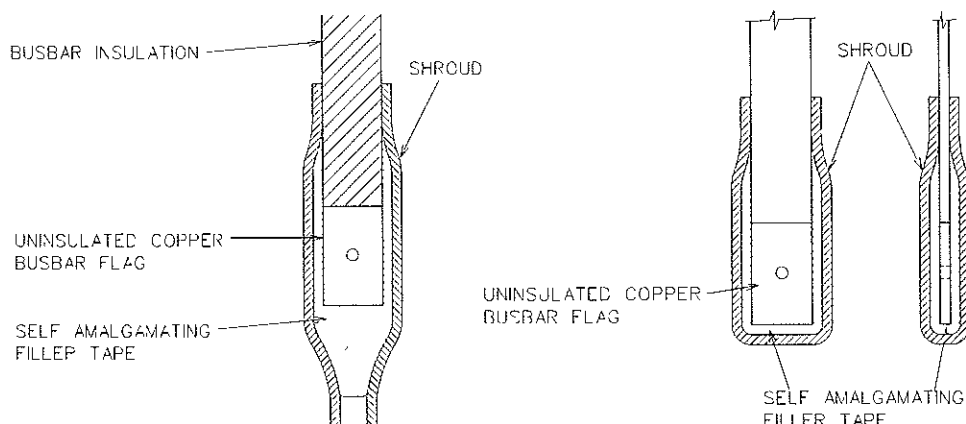


Figure 4 – Shrouding options for un-used cable terminal fixing points (busbar flags)

5.13.8 For 800 A panels, individual cable support clamps in accordance with D-DT-8019 and suitable for an outer cable diameter of 25 – 50 mm shall be fitted below each terminal fixing point (busbar flag)

5.13.9 For 1250 A and 2500 A panels, individual cable support clamps in accordance with D-DT-8019 and suitable for an outer cable diameter of 50 – 75 mm shall be fitted below each terminal fixing point (busbar flag)

5.13.10 The distance from the cable support clamp centre line to the terminal fixing centre line shall be in accordance with Table 6 and as shown in Figure 4 The distance offered shall be stated in schedule B

NOTES

- 1 Preference will be given to cable termination enclosures that do not extended into the cable trench

Table 6 — Distance from terminal centre 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	700

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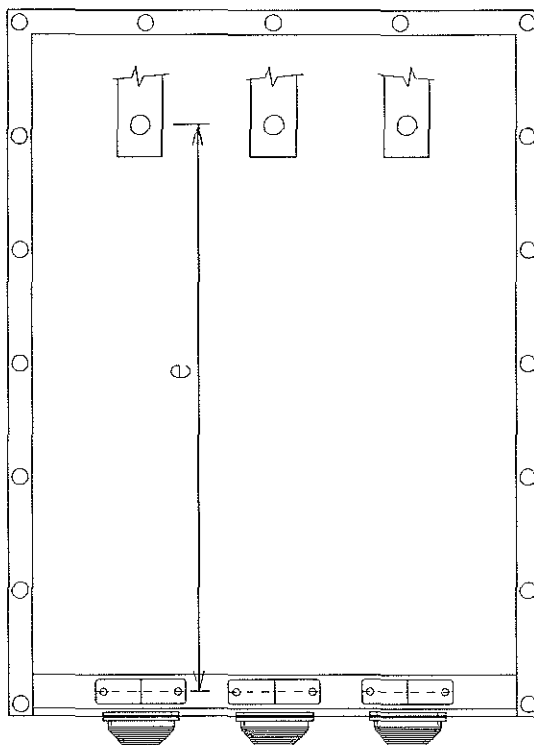


Figure 5 – Typical cable compartment showing distance from cable support clamp to terminal fixing centre line

5.13.11 Vermin proofing plates of minimum thickness of 2 mm shall be 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). Alternatively, the plates shall be slotted between cable entry holes. The material and thickness of the vermin proofing plates offered shall be stated in schedule B.

5.13.12 . The vermin proofing plates shall have pre-drilled/punched cable entry holes of size \varnothing 60mm that are positioned to correspond with the cable support clamp positions.

5.13.13 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.

5.13.14 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 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

5.14.1 When specified in the switchgear ordering schedule, the feeder panel cable compartment shall be fitted with surge arresters. Surge arresters shall be in accordance with 240-56030659 and D-DT-6214/D-DT-6215/D-DT-6216 or alternatively, where indoor shrouded surge arresters are required to achieve the required clearances, they shall be in accordance with 240-56030619 and D-DT-8010. The surge arrester make, product code, type, line discharge class, nominal discharge current (I_n), rated voltage (U_r), maximum continuous operating voltage (MCOV),

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maximum residual voltage (V_{res}) and creepage distance shall be stated in schedule B. A data sheet for the surge arresters offered shall be included with the tender documentation (refer to 5.24.1)

5.14.2 A separate and accessible point of attachment (busbar flag) with an M16 fixing hole shall be provided for each surge arrester.

5.14.3 Unless otherwise accepted by Eskom, the lead used to connect each surge arrester to the busbar flag provided shall be an insulated flexible copper conductor having a minimum cross-section area of 16 mm² and shall be fitted with a lug having an M16 fixing hole.

5.14.4 Surge arresters shall be earthed (commoned) using a copper earthing bar in accordance with 5.7.1. The set of three surge arresters shall be earthed to the main earthing bar with a copper earthing bar in accordance with 5.7.1. Alternatively, a flexible (stranded) copper conductor having a minimum cross-section area of 16 mm² and fitted with lugs having M12 fixing holes may be used to bond the surge arresters to the main earthing bar.

5.14.5 It shall be possible to disconnect and remove the surge arresters to facilitate over-voltage testing of the switchgear at commissioning stage.

NOTE: Straight shrouds will be fitted over the surge arrester terminal fixing points by Eskom on site.

5.14.6 For surge arrester testing purposes, surge arresters shall be directly accessible once the rear cable compartment cover has been removed. Cable terminations shall not interfere with or prevent access to the surge arresters.

5.14.7 If the position of the surge arresters affects access to the cable terminations, it shall be possible to disconnect and remove the surge arresters in order to terminate the cables.

5.14.8 The designed clearance requirements shall not be reduced by virtue of the fact that the surge arresters are fitted.

5.15 COMPARTMENT HEATERS

5.15.1 Suitably rated electric heaters shall be located inside the cable and circuit-breaker compartments to prevent moisture from condensing and being deposited inside each of the defined panel compartments. Depending on the switchgear design considerations (e.g. location of busbar compartment relative to other heated compartments, busbar support method, etc.), switchgear performance history and OEM recommendations, Eskom reserves the right to request additional heaters in the busbar compartment(s). The heater size offered for each compartment shall be stated in schedule B.

5.15.2 Heaters shall maintain a dewpoint greater than the ambient temperature and shall circulate the air constantly to all parts of the enclosure.

NOTE: The use of humidity transducers to control the dewpoint and prevent condensation within the switchgear compartments will be considered.

5.15.3 Heaters shall be placed to avoid damage to temperature-sensitive components. Heater elements shall, where applicable, be protected and leads, which are heated by the conduction of heat from the element, shall be insulated by heat-resistant insulating material, e.g. ceramic beads or silicone rubber. The type of insulating material offered shall be stated in schedule B.

5.15.4 The electrical supply for heaters shall be single-phase 230 V a.c.

5.15.5 The heater control circuits shall comply with the requirements of 240-56063705 and D-DT-5408.

5.16 POSITION / STATUS INDICATION

5.16.1 Position / status indicators on the LV compartment door (off-board protection schemes only)

5.16.1.1 Each switchgear panel shall have the following definite position / status indication located on the outside of the LV compartment door:

- a) circuit-breaker contact status (open/closed),

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- b) circuit-breaker racked in/out status (service position/test position), and
- c) earthing switch applied status (open/closed).

5.16.1.2 The position / status indicators shall be displayed as a schematic mimic via LED indicators. Incandescent lamps shall not be used. The layout of the mimic shall be shown as part of the panel layout on the general arrangement drawings. A "lamp check" push-button function shall be provided which when pressed causes all LED indicators to be illuminated.

5.16.2 Cable 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 Position / status indication on circuit-breakers and earthing switches

5.16.3.1 The circuit-breaker and earthing switch mechanical position indication shall be in accordance with SANS 62271-200. The following symbols and colours shall be used:

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

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

5.16.3.3 The 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 5 mm. No symbols shall be used for indication purposes.

5.16.3.4 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.

5.16.3.5 All status indicating devices shall be clearly visible from in front of the switchgear panel with the doors closed – through openings in the switchgear panel doors.

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-proof.

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.

5.17.1.5 All paint colours shall be standard colours in accordance with SANS 1091.

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5.17.2 Warning labels

5.17.2.1 Busbar orifice shutters shall be painted signal red in accordance with colour A11 of SANS 1091. Busbar orifice shutters shall be labelled "BUSBAR" in white letters at least 50 mm high (on the shutters)

5.17.2.2 In a bus-section panel, the busbar orifice shutters shall be marked with white arrows to distinguish the left-hand and right-hand busbars, when viewed from the front of the panel

5.17.2.3 Cable orifice shutters shall be painted canary yellow in accordance with colour C61 of SANS 1091. Cable orifice shutters shall be labelled "CABLE" in white letters at least 50 mm high (on the shutters)

5.17.2.4 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

5.17.2.5 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

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
- c) *Instructions for mechanically opening and closing the earthing switch* These instructions shall be titled "TO OPEN EARTHING SWITCH" and "TO CLOSE EARTHING SWITCH", respectively. Additional information required to perform these functions shall be referred to Eskom. These labels shall be located on the door of the compartment housing the earthing switch.

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5.17.4.2 The actuator(s) for local opening and closing of the circuit-breaker 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" 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 the circuit-breaker and clockwise to close the circuit-breaker. Trip and close push buttons shall be oriented vertically or horizontally and shall have the trip button at the bottom or to the left of the close button [IEC 60447], and
- c) by colour coding. The colour green shall be associated with the trip control and red with the close control. Alternatively the controls shall be without unique colour

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

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

- a) to *trip / rack-out* the circuit-breaker, green push-button with the "O" symbol – labelled "TRIP / RACK-OUT"
- b) to *close / rack-in* the circuit-breaker, red push-button with the "I" symbol – labelled "CLOSE / RACK-IN".

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)

5.17.4.4 A label shall be provided on each circuit-breaker/VT/CPAT compartment door with the instruction as follows "DOOR INTERLOCKED AND CAN ONLY BE OPENED WHEN THE CIRCUIT-BREAKER/VT/CPAT IS RACKED OUT" (black text on white background)

5.17.4.5 Where front access (in addition to rear access) is provided to the cable compartment, a label shall be provided on each cable compartment door with the instruction as follows "DOOR INTERLOCKED AND CAN ONLY BE OPENED WHEN THE CABLE IS EARTHED" (black text on white background).

5.17.4.6 The switchgear tool cabinet (refer to 5.23) door shall be labelled as follows "SWITCHGEAR OPERATING TOOLS AND MANUALS" (black text on white background)

5.17.5 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.

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 Panel colour coding and labels

5.17.6.1 The switchgear panels shall be colour coded according to their function as specified in Table 7

5.17.6.2 All removable busbar compartment covers shall be signal red in accordance with colour A11 of SANS 1091

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

5.17.6.4 The LV compartment door shall be labelled as follows "LV COMPARTMENT" (black text on white background)

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Table 7 – Colour coding of switchgear panels

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
Voltage Transformer Panel	Golden Yellow	B49	1070-Y20R
Control Power Transformer Panel	Avocado Green	C12	6020-Y

5.18 CURRENT TRANSFORMERS

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

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

5.18.6 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

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

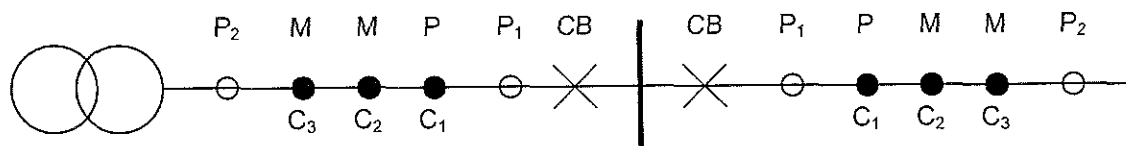


Figure 6 – CT positioning for all indoor applications

5.19 VOLTAGE TRANSFORMERS (VTS) AND CONTROL POWER AUXILIARY TRANSFORMERS (CPAT'S)

5.19.1 Voltage transformers and auxiliary power transformers shall be of the withdrawable design and shall be located in a separate dedicated panel, accessible from the front

NOTE For safety reasons, due to the internal arc classification and associated arc venting design, voltage transformers are no longer fitted on top of any functional unit and/or in the vicinity of pressure relief devices

5.19.2 Voltage transformers (VTs) shall be of the dry-type and manufactured and tested in accordance with SANS 60044-2 The make of VT offered shall be stated in schedule B

5.19.3 Control auxiliary power transformers (CPATs) shall be of the dry-type. The make of CPAT offered shall be stated in schedule B

5.19.4 The VT specification (ratio, class, rated voltage factor and core construction) and CPAT specification (primary voltage, no-load secondary voltage, continuous rating) shall be in accordance with the relevant sheet of D-DT-5408

5.19.5 VTs and CPATs shall have suitably rated fuse protection on the primary sides as shown in D-DT-5408

5.19.6 The medium-voltage fuses on the primary side shall be in accordance with SANS 60282-1 The make, type designation, ratings and class (in accordance with SANS 60282-1) of fuses offered shall be stated in schedule B

5.19.7 The VT and CPAT 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

5.21.1 Each switchboard shall make provision for the fitment of arc detection protection system equipment

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5.21.2 Arc sensors applicable to a particular switchboard shall be free-issued by Eskom, but fitted by the supplier in accordance with 240-56063705

5.21.3 Where vacuum interrupters are used, the arc sensors shall be positioned such that light emitted from the arc inside the vacuum interrupter during operation does not cause spurious operation of the arc detection protection system.

NOTE This requirement is not applicable to embedded pole or resin encapsulated vacuum interrupters

5.22 NAMEPLATES

5.22.1 Each switchgear panel shall be labelled in accordance with the nameplate requirement of SANS 62271-200. In addition to the requirements of SANS 62271-200, the Eskom order number shall also be included only on the switchgear panel nameplate information

5.22.2 Each circuit-breaker shall be separately labelled in accordance with the nameplate requirement of SANS 62271-100. The following additional information shall be provided for the circuit-breaker operating mechanism.

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

5.22.3 Each current transformer, voltage transformer and control power transformer shall be separately labelled in accordance with the nameplate requirements of their applicable standards

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

5.22.5 Duplicate nameplates for the circuit-breaker, voltage transformer or control power 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 located in the cable compartment of the switchgear panel shall be located on the inside of the LV compartment door

5.22.7 The actual ratings of the equipment (e.g. circuit-breaker), and not merely the values specified by Eskom, shall be displayed

5.22.8 Nameplates shall be manufactured and attached in accordance with 5.17.1. Alternatively, nameplates shall be manufactured using corrosion-proof metallic nameplates (e.g. aluminium). Information shall be durably applied (e.g. engraved). 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. racking handle, spring charging handle, earthing switch operating handle, 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 and racking) 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

5.23.3 Where applicable, the externally mounted motorised racking device shall be supplied with each switchboard (refer to 5.10). If additional externally mounted motorised racking devices are required, this shall be specified in the switchgear ordering schedule

5.23.4 Where external transporting devices are provided for withdrawable equipment (circuit-breakers, VTs, etc.), one transporting device for every bus-section shall be supplied with each switchboard. For different sized panels, additional matching transporting devices shall be supplied for every bus-section. If additional external transporting devices are required, this shall be specified in the switchgear ordering schedule.

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

5.23.5 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)

5.23.5.1 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

5.23.5.2 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.

5.23.5.3 The colour of the tool cabinet shall be in accordance with 5 17 6.3.

5.23.5.4 Corrosion protection of the tool cabinet shall be in accordance with 5 11 4

5.23.5.5 The tool cabinet shall be labelled in accordance with 5.17.4.6

5.23.6 A detailed list of standard tools required for minor maintenance shall be supplied with the tender documentation (refer to 5.24 1) Where applicable, the following tools are required for minor maintenance.

- a) slow operating device(s),
- b) hoses and fittings for draining and filling with SF₆ gas; and
- c) other tools which may be required (e.g. contact alignment tools, SF₆ density meter checking device).

5.23.7 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 6 and 5 23 7
- 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

5.23.8 A full list of spares required for maintenance shall be provided with the tender documentation (refer to 5.24 1)

5.23.9 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

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,

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- location and overall dimensions of various compartments as defined in this specification,
 - location of internal arc pressure relief flaps,
 - *position of earth terminals or bars,*
 - location of compartment heaters, and
 - minimum design creepage distance (indicating whether specific creepage distance or unified specific creepage distance),
 - 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 centre line,
 - spacing between cable terminal fixing points (phase to phase and phase to earth),
 - number of cable terminal fixing points (busbar flags) per phase,
 - *location of surge arresters and dedicated fixing points (busbar flags),*
 - location of CTs,
 - location of cable termination earth terminals or bars,
 - cable trench overhang dimensions,
 - minimum width of cable trench required,
 - minimum distance required from the rear of the panel to rear switch room wall, and
 - location of cable earthing switch,
 - circuit-breaker panel drawings shall show the following additional information.
 - location of circuit-breaker and operating mechanism,
 - location of mechanical trip button,
 - location of status indication on circuit-breakers and earthing switches, and
 - location of the orifice shutters;
 - VT and CPAT panel drawings shall show the following additional information
 - location of VT and CLT, and
 - location of busbar earthing switch (VT panel with integral earthing switch),
 - *location of all mechanical operating tool insertion positions (as applicable for each panel type),*
 - position and wording of all labels specified in this specification,
 - colour coding relevant to the type of panel;
 - 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, CTs, VTs, CPATs) 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);

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- f) detailed list of tools required for minor maintenance (refer to 5.23 6),
- g) detailed list of additional specialised tools for major (specialised) maintenance (refer to 5.23 7);
- h) full list of spares required for maintenance (refer to 5.23 8 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:
 - special requirements or limitations for installation (refer to 5.11.1.2),
 - design details of the floor racking plates (refer to 5.11.5.4),
 - details of such uni-struts / frame / support for proper levelling of panels (refer to 5.11.5.5);
 - data sheet for the surge arresters offered (refer to 5.14.1),
 - 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

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.

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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 applicable 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. Unless otherwise accepted by Eskom, type test reports shall not be older than ten years. 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:

- equipment insulation level (SANS 62271-200 6.2);
- temperature rise and measurement of resistance of circuits (SANS 62271-200 6.5 & 6.4);
- current withstand – main circuit (SANS 62271-200 6.6);
- current withstand – earthing circuit (SANS 62271-200 6.6);
- circuit breaker short-circuit making and breaking capacities (SANS 62271-200 6.101 and SANS 62271-100 6.102 to 6.106);
- circuit-breaker critical current tests (where applicable) (SANS 62271-100 6.107);
- circuit-breaker double earth fault tests (SANS 62271-100 6.108);
- circuit-breaker out-of-phase making and breaking tests (applicable if an out-of-phase rating is assigned) (SANS 62271-100 6.110);
- circuit-breaker capacitive current switching tests (SANS 62271-100 6.111.5);
- circuit-breaker electrical endurance tests (SANS 62271-100 6.112);
- earthing switch making capacity (SANS 62271-200 6.101 and SANS 62271-102 6.101) – where applicable;
- circuit-breaker mechanical operation test (SANS 62271-200 6.102 and SANS 62271-100 6.101.2.1 - 6.101.2.3);
- circuit-breaker extended mechanical endurance tests (for class M2 circuit-breakers) (SANS 62271-100 6.101.2.4);
- mechanical operation for the withdrawable circuit-breaker intended to be used as a disconnecter (SANS 62271-200 6.102.1 and SANS 62271-102 6.102);

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- earthing switch mechanical operation (SANS 62271-200 6.102) – where applicable;
- test to verify the proper functioning of the position indicating device for the earthing switch (SANS 62271-102 6.105) – where applicable;
- verification of the protection (IP coding and mechanical impact) (SANS 62271-200 6.7);
- tightness test (SANS 62271-100 6.8);
- x-radiation test procedures for vacuum interrupters (SANS 62271-200 6.11);
- internal arc (SANS 62271-200 6.106);
- partial discharge test (SANS 62271-200 6.2.9);
- 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.

- 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

- dielectric test on the main circuit (SANS 62271-200 7.1);
- 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)

- measurement of the resistance of the main circuit (SANS 62271-200 7.3);
- tightness test (SANS 62271-200 7.4);
- design and visual checks (SANS 62271-200 7.5);
- partial discharge measurement (SANS 62271-200 7.101);
- mechanical operating tests on circuit-breaker (SANS 62271-200 7.102 and SANS 62271-100 7.101); and
- 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 CPATs shall be type and routine tested in accordance with their relevant standard

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

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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:

- **80 % power-frequency voltage tests of the main circuits in accordance with SANS 62271-200 7.105;**
- **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);**
- **verification of remote control operation using the hand-held remote control unit for circuit-breaker switching and racking in and out of withdrawable parts.**

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

- **verification of the rated operating sequence; and**
- **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:

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

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

- **measurement of resistance of the main circuits of the assembly in accordance with SANS 62271-200; and**
- **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.

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.

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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
- 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

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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
- 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:
 - procedures for carrying out any adjustment that may be necessary to achieve correct operation;
 - recommendations for any relevant measurements that should be made and recorded to help with future maintenance decisions; and
 - instructions for final inspection and testing

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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.

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

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,

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.

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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:

- 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,

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- 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.

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,

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- 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 5.23.8) 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;
- spring charging motors, and
- racking 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).

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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.

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

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- 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,
- 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

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- 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

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

12 AUTHORISATION

This document has been seen and accepted by

Name & Surname	Designation
	Document Approved by TDAC ROD 13 March 2013
Roger Cormack	Senior Manager HV Plant
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13 REVISIONS

Date	Rev.	Compiler	Remarks
November 2012	0	B Mwarehwa	Draft document for review created from 36-184 Rev 0
May 2013	1	B Mwarehwa	Final for signature
August 2013	2	T Du Plessis / B Mwarehwa/ C Bosch	<p>Added options for 11 kV, 22 kV and 33 kV 31.5 kA panel options</p> <p>Allowed for the new wiring standard requirements</p> <p>Added a 630A feeder panel option</p> <p>5.10.12 Circuit breaker interlocked to or out in closed position</p> <p>5.11.1.7 added dimensions for 11kV 25 20kA</p> <p>5.11.1.7 included the requirements for dimensions for 11kV 25kA</p> <p>5.11.2 PTM&C requirements were added to compartment</p> <p>5.11.2.4 Added New onboard cutout</p> <p>5.11.5.4 Definition of truck type</p> <p>5.11.5.2 the amount of trolley devices confirmed with the purchase</p> <p>5.12.2 minimum creepage distance in per SANS</p> <p>Table 5 included 2000A incomer</p> <p>5.13.10 Disallows the use of trench drain</p> <p>Table 6 added option for 33kV</p> <p>5.13.12 the hole size to be 60mm and to be completed in the B schedule</p> <p>5.13.14 The requirement for 700mm removed from note.</p> <p>5.16.2 cable life indication spare stat shall be wired.</p> <p>5.18.7 One set of Protection CT core provided in bus section circuit applications</p> <p>5.19 the control power transformer the control power auxiliary transformer (CPAT).</p> <p>5.21.2 Note removed</p>

14 DEVELOPMENT TEAM

The following people were involved in the development of this specification

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The original specification DISSCAAK3 was compiled by Craig Clark

The 1st revision of DSP 34-1157 was compiled by Johan Jordaan and revised by Rhett Kelly

The 1st revision of 240-56065131 was compiled by Thinus du Plessis and Brighton Mwarehwa

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N. Booyens	DBOUS SI KZN
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A Persadh	IARC (Engineering Processes)
J Wilson	Eastern Region
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15 ACKNOWLEDGEMENTS

None

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APPENDIX A: SUPPLIER AND ESKOM RESPONSIBILITIES

(Normative)

16 THE RESPONSIBILITIES OF ESKOM AND THE SUPPLIER OF THE SWITCHGEAR AND ASSOCIATED EQUIPMENT SHALL BE AS DEFINED BELOW.

16.1 SUPPLIER'S RESPONSIBILITIES

The supplier shall be responsible for the following

upon submission of a tender, the submission of a complete set of technical documents as required by this specification (refer to clause 5.24 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,

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),

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,

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,

the supply of the complete switchboard assembly (all switchgear panels including circuit-breakers, CTs, VTs, etc.) in accordance with the Eskom switchgear ordering schedule,

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,

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),

the wiring and fitment of all arc detection protection system equipment (i.e. arc detection sensors, slave relays and arc fault monitoring relays) applicable to a particular switchboard,

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.

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.

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provision of a full set of operating tools (including hand-held remote control units, circuit-breaker transporting devices (trolleys), racking plates, etc (where applicable)) for each switchboard as detailed in this specification and in accordance with the Eskom switchgear ordering schedule;

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;

provision of OEM accredited installation and pre-commissioning services for all on-site work,

the installation of the complete switchboard on-site – pre-commissioned, tested and ready for handover,

provision of all documentation relevant to the switchgear including routine factory test reports and the on-site testing records;

provision of all specified training in accordance with DSP 34-2207 by OEM accredited trainers;

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;

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

any other responsibilities as specified in this document.

16.2 ESKOM'S RESPONSIBILITIES

Eskom shall be responsible for the following

the supply of the relevant specification(s) and completed schedule A's with the enquiry,

the supply of a fully completed switchgear ordering schedule for each switchboard ordered,

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,

when required, the assessment and evaluation of the relevant manufacturing facilities,

when required, the assessment and evaluation of the relevant transport, installation and pre-commissioning facilities,

the approval of all drawings submitted by the supplier (e.g. general arrangement, nameplate, schematic wiring, etc.),

the approval of all other documentation provided by the supplier (e.g. manuals, training material, etc.),

where applicable, the supply and delivery to the supplier of free-issue arc detection sensors, slave relays and arc fault monitoring relays – together with the arc detection protection system schematic diagram applicable to a particular switchboard,

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

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

the inspection and factory acceptance of switchgear prior to dispatching from supplier's factory to site for installation,

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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,

the supply and termination of all external power cabling into the relevant cable compartments;

the supply and installation of external control cabling and wiring to the terminals provided in the LV compartment,

where applicable, the supply and installation of all off-board protection and control schemes remote from the switchgear panel,


if necessary, provide suitable storage facilities where switchboards are to be stored for extended durations *prior to installation due to unplanned delays; and*

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APPENDIX B: MODEL SWITCHGEAR ORDERING SCHEDULE

(informative)

		METAL CLAD ORDERING SCHEDULE		Page 1
				Rev 4 2

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

Schedule A Purchasers specific site requirements DSP 34-1157

1	2		3	
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 <u>11</u> kV Switchboard busbar rating <u>A 1250</u> 		
	Type	SAP No	PANEL DESCRIPTION	DRW
P01	N/A	-	-	-
P02	N/A	-	-	-
P03	N/A	-	-	-
P04	N/A	-	-	-
P05	N/A	-	-	-
P06	N/A	-	-	-
P07	N/A	-	-	-
P08	N/A	-	-	-
P09	N/A	-	-	-
P10	N/A	-	-	-
P11	N/A	-	-	-
P12	N/A	-	-	-
P13	N/A	-	-	-
P14	N/A	-	-	-
P15	N/A	-	-	-
P16	N/A	-	-	-
P17	N/A	-	-	-
P18	N/A	-	-	-
P19	N/A	-	-	-
P20	N/A	-	-	-
P21	N/A	-	-	-
P22	N/A	-	-	-
P23	N/A	-	-	-
P24	N/A	-	-	-
P25	N/A	-	-	-
P26	N/A	-	-	-
P27	N/A	-	-	-
P28	N/A	-	-	-
P29	N/A	-	-	-
P30	N/A	-	-	-
P31	N/A	-	-	-
P32	N/A	-	-	-
1 2	<ul style="list-style-type: none"> Number of sets of standard operating tools/spares required <u>Number 1</u> 			
1 3	<ul style="list-style-type: none"> On-board protection and control schemes required <u>Yes/No No</u> 			
1 4	<ul style="list-style-type: none"> Delivery effected not before <u>Date ??</u> 			
1 5	<ul style="list-style-type: none"> Erection and pre-commissioning completed not later than <u>Date ??</u> 			
	Note 1) Details of existing switchboard are shown on the schematic (dashed lines) 2) The default location for protection and control schemes is "off-board" in a separate control room 3) Irrespective of the type (PILC or XLPE) and number (per phase) of cables to be terminated (see schematic diagram), the cable termination compartment shall always be the same and in accordance with NRS 012 Ed 2 4) Rubber grommets (D-DT-8027) for each pre cut hole in the AI vermin proofing plate and corresponding cable support clamps (D D T-8019) shall be fitted. If specified, surge arresters shall be fitted to dedicated terminals in feeder panels			

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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: This is a comment section of the schedule. To add information in this section click and type your special comments to the manufacturer / supplier 1) There can be more than one note to the manufacturer in this section If no instruction is required, select this text and then delete	
SCHEDULE COMPLETED BY (PROJECT ENGINEER):		
Name ??		Date ??
Signature		
Contact Number ??		

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Eskom		METAL CLAD SWITCHGEAR ORDERING SCHEDULE														Page 2
																Rev 4 2
Project Number	??															
Project Name	??															
PANEL LAYOUT																
	P01 N/A	P02 N/A	P03 N/A	P04 N/A	P05 N/A	P06 N/A	P07 N/A	P08 N/A	P09 N/A	P10 N/A	P11 N/A	P12 N/A	P13 N/A	P14 N/A	P15 N/A	P16 N/A
Colour	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SAP No	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Busbar rating [A]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Breaker rating [A]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cable SA required	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Power Cable Type	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
No of cables/phase	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cable size mm ²	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CT Requirement	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Specific Note Ref	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COMPLETED BY																
Name	??										Date ??					
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 5.7 (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 5.7) (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 5.7 (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, racking-in and racking-out of circuit-breaker) 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 racking device(s) using hand-held remote control unit for each panel type (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 of live-conductors in air in all panel compartments 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 Acceptance Checklist

The following shall be verified and tested during the factory acceptance testing (FAT)		
Item	Checked (√)	Requirement
14		Verify provision of compartment heaters and heater wiring for compliance with 5 15 and 240-56063705 and D-DT-5408
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 17
17		Verify all CTs, VTs, CPATs and associated wiring for compliance with 240-56063705 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 arc detection protection system equipment installation in accordance with 240-56063705 and D-DT-5408.
20		Verify all nameplates for compliance with 5 22
21		Verify provision of all tools and tool cabinet in accordance with 5.23
22		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)

17 MODEL FORMS OF TECHNICAL SCHEDULES

17.1 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.

17.2 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.

17.2.1 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.

17.2.2 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.

17.2.3 Deviation Schedule

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

NOTES

- 1 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.
- 2 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.
- 3 These schedules, when completed, become normative annexes to the enquiry specification.

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17.2.4 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.

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.

17.3 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.

17.4 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.

17.5 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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Technical Schedules A and B for MV metal-enclosed switchgear

Schedule A: Purchasers specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

TECHNICAL SCHEDULES A & B FOR 11 kV, 22 kV AND 33 kV WITHDRAWABLE PATTERN AIR-INSULATED 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 DSP 34- 1157	Description	Schedule A	Schedule B
1		Item and system description		
		Select item from list . . .		
1 1		• SAP No	_____	XXXXXXXXXX
1 2		• Buyers Guide Drawing	_____	XXXXXXXXXX
1 3	5 3	• Panel application	_____	XXXXXXXXXX
1 4	4.1	• Nominal system voltage kV	_____	XXXXXXXXXX
1.5		• System voltage range pu	0,9 to 1,1	XXXXXXXXXX
1 6	5 1 2	• System earthing (effective/non effective)	Non-effective	XXXXXXXXXX
		<input type="checkbox"/>		
2		Ratings		
2 1	4 1	• kV	_____	
		Rated voltage (U_r)		
2 2	4 1	• Number of phases	3	
2.3	4 2	• Rated short-duration power-frequency withstand voltage (U_d) kV	_____	
			—	
2 4	4 2	• Rated peak lightning impulse withstand voltage (U_p) kV	_____	
2 5	4 3	• Rated frequency (f_r) Hz	50	
2 6	4 4	• Rated normal current (I_r) - busbar main circuit A	_____	
2.7	4 4	• Rated normal current (I_r) - circuit- A	_____	

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		breaker main circuit		—	
2 8	4.5	• Rated short-time withstand current (I_k and I_{ke})	kA	—	
2 9	4 6	• Rated peak withstand current (I_p and I_{pe})	kA	—	
2 10	4 7	• Rated duration of short circuit (t_k) - main circuit and earthing switch	s	3	
2 11	4.7	• Rated duration of short circuit (t_{ke}) - earthing circuit	s	1	
2 12	4 8	• Rated d.c. supply voltage of closing and opening devices and of auxiliary and control circuits (U_a)	V	110	
2 13	4 8	• Rated a.c. supply voltage of heaters and other a.c. auxiliary circuits (U_a)	V	230	
2 14	4 9	• Rated supply frequency of closing and opening devices and of auxiliary and control circuits	Hz	d.c	
2 15	4 9	• Rated supply frequency of heaters and other a.c. auxiliary circuits	Hz	50	
2 16	4 101	• Rated short-circuit breaking current (I_{sc}) of circuit-breaker	kA	—	
2 17	4 102	• Circuit-breaker class		—	
2.18	4 102	• First-pole-to-clear factor (k_{pp}) for circuit-breaker		—	
2.19	4 102	• Standard values of TRV related to the rated short-circuit breaking current (SANS 62271-100)		—	
2.20	4 103	• Rated short-circuit making current of circuit-breaker and earthing switch	kA	—	
2.21	4 104	• Rated operating sequence for circuit-breaker		—	
2 22	4 104	• Minimum resting time following rated operating sequence	min	xxxxxxxxxx	
2 23	4 105	• Characteristics for short-line faults		N/A	
2 24	4 106	• Rated out-of-phase making and breaking current for circuit-breakers	kA	xxxxxxxxxx	
2 25	4.107	• Classification of circuit-breaker according to its restrike performance (line- and cable-charging breaking current)		—	
2.26	4.107	• Rated capacitive switching currents for circuit-breaker - line-charging breaking current	A	—	
2 27	4 107	• Rated capacitive switching currents for circuit-breaker - cable-charging breaking current	A	—	
2 28	4 107	• Classification of circuit-breaker according to its restrike performance (capacitor bank breaking current)		—	

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2 29	4 107	• Rated capacitive switching currents for circuit-breaker - single capacitor bank breaking current	A	_____	
2 30	4 107	• Rated capacitive switching currents for circuit-breaker - back-to-back capacitor bank breaking current	A	_____	
2 31	4.107	• Rated capacitive switching currents for circuit-breaker - back-to-back capacitor bank inrush making current	kA	_____	
2 32	4 108	• Inductive load switching for circuit-breaker		xxxxxxxxxx	
2 33	4 109	• Rated opening time for circuit-breaker	ms	xxxxxxxxxx	
2.34	4 109	• Rated break-time for circuit-breaker	ms	xxxxxxxxxx	
2 35	4 109	• Rated closing time for circuit-breaker	ms	xxxxxxxxxx	
2 36	4 109	• Rated open-close time for circuit-breaker	ms	xxxxxxxxxx	
2.37	4 109	• Rated reclosing time for circuit-breaker	ms	xxxxxxxxxx	
2.38	4 109	• Rated close-open time for circuit-breaker	ms	xxxxxxxxxx	
2 39	4 109	• Rated pre-insertion time for circuit-breaker	ms	xxxxxxxxxx	
2 40	4.110	• Circuit-breaker mechanical endurance class		_____	
2 41	4.110	• Number of mechanical operations for circuit-breaker		_____	
2.42	4 111	• Classification of circuit-breakers as a function of electrical endurance		_____	
3					
	5 1	Service conditions			
3.1	5 1 1	• Location (indoors/outdoors)		Indoors	
3 1	5.1 1	• Ambient air temperature range	°C	-5 to +40	
3.2	5 1 1	• Altitude (amsl)	m	up to 1800	
3 3	5 1 1	• Class of pollution (SANS 60815-1:2009)		Medium ('c')	
3 4	5 1 1	• Average humidity	%	up to 95	
3 5	5.1.1	• Condensation		Yes	
4					
	5.2	General			
4 1	5.2.1/5 2 2	• Withdrawable pattern air-insulated metal-enclosed switchgear compliant to SANS 62271-200		Yes	
4.2		• Panel manufacturer		xxxxxxxxxx	
4 3		• Panel country of origin		xxxxxxxxxx	
4.4		• Panel model/type designation		xxxxxxxxxx	
4 6		• Panel total mass	kg	xxxxxxxxxx	
4 7	5 2 3	• Circuit-breakers compliant to SANS 62271-100		Yes	
4 8		┐ - Circuit-breaker manufacturer		xxxxxxxxxx	
4 9		┐ - Circuit-breaker country of origin		xxxxxxxxxx	

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4 10		<input type="checkbox"/> - Circuit-breaker model/type designation	xxxxxxxxxx	
4 11		<input type="checkbox"/> - Circuit-breaker total mass (with operating mech) kg	xxxxxxxxxx	
4 12		<input type="checkbox"/> - Isolation displacement (vertical/horizontal) for withdrawable parts	xxxxxxxxxx	
4 13	5 2 4	<input type="checkbox"/> - Circuit-breaker number of poles	3	
4 14	5 2 4	<input type="checkbox"/> - Stored energy operation for circuit-breaker mechanism	Yes	
4.15	5 2.4	<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 16	5 2 4	<input type="checkbox"/> - Manual and motorised spring charging	Yes	
4 17	5 2 4	<input type="checkbox"/> - Manual and electric energy release	Yes	
4 18	5.2 5	<input type="checkbox"/> - Mechanical TRIP and CLOSE control facility (only TRIP control to be available on the front of the panel)	Yes	
4 19	5 2.6	<input type="checkbox"/> - Circuit-breaker interrupting technology (Vacuum/SF ₆)	Vacuum	
		<input type="checkbox"/>		
5	5 3	Architecture and accessibility to compartments		
5 1	5 3 1	• Single busbar design	Yes	
5.2	5 3	• Busbar configuration (Horizontal/Vertical/Delta)	xxxxxxxxxx	
5 3	5 3	• Bus-section/coupler switching device	N/A	
5 4	5 3	• Circuit-breaker/VT/CPAT withdrawable with self-alignment device	Yes	
	5 3 2	• Separate compartments required for:		
5.5		<input type="checkbox"/> - Withdrawable part (circuit-breaker/VT/CPAT)	Yes	
5 6		<input type="checkbox"/> - Busbar	Yes	
5.7		<input type="checkbox"/> - Power cable/CT (feeder/incomer panels only)	Yes	
5 8		<input type="checkbox"/> - LV equipment	Yes	
5 9	5 3.5	• Accessibility to circuit-breaker, VT and CPAT compartments	Interlock-controlled	
5 10	5 3.5	• Rear accessibility to busbar and cable compartments (where applicable)	Tool-based	
5.11	5 3 6	• Accessibility to cable compartments (if additional access provided from front)	Interlock-controlled	
		<input type="checkbox"/>		
6	5 4	Service continuity of the switchgear		
6.1	5 4	• Loss of service continuity category	LSC2B	

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7	5.5	Partition class and shutters		
7.1	5.5.1	<ul style="list-style-type: none"> Partitioning class (partitions and/or shutters) 	PM	
7.2	5.5.2	<ul style="list-style-type: none"> Shutter operation positively driven in both directions 	Yes	
7.3	5.5.3	<ul style="list-style-type: none"> Shutters automatically operated by the movement of the withdrawable part 	Yes	
8	5.6	Internal arc classification		
8.1	5.6.1	<ul style="list-style-type: none"> Internal arc classification 	AFLR	
8.2	5.6.2	<ul style="list-style-type: none"> Classification test current value kA 	_____	
8.3	5.6.2	<ul style="list-style-type: none"> Classification test current duration s 	1	
8.4	5.6.3	<ul style="list-style-type: none"> Pressure relief direction 	Upwards	
8.5	5.6.6	<ul style="list-style-type: none"> Ducting required for venting outside switchroom (Yes/No) 	_____	
9	5.7	Earthing circuit and earthing devices		
9.1	5.7.1	<ul style="list-style-type: none"> Cross section dimensions of the earthing bars (earthing circuit) mm 	_____	
9.2	5.7.1	<ul style="list-style-type: none"> M12 fixing holes provided in earthing bars 	Yes	
9.3	5.7.2.1	<ul style="list-style-type: none"> Type of cable earthing switch provided 	Integral / circuit-breaker	
9.4	5.7.2.1	<ul style="list-style-type: none"> Cable earthing switch class (min) 	Class E1	
9.5	5.7.2.2	<ul style="list-style-type: none"> Type of busbar earthing switch provided 	N/A	
9.6	5.7.2.2	<ul style="list-style-type: none"> Busbar earthing switch class (min) 	N/A	
9.7	5.7.2.3	<ul style="list-style-type: none"> Integral earthing switches compliant to SANS 62271-102 with independent unlatched operation 	N/A	
9.8	5.7.2.4	<ul style="list-style-type: none"> Isolation of trip circuit if circuit-breaker is in earthed position (where applicable) 	N/A	
9.9	5.7.2.5	<ul style="list-style-type: none"> Cable earth interlocking system provided in accordance with 5.7.2.5 	Yes	
9.10	5.7.2.6	<ul style="list-style-type: none"> Busbar earth interlocking system provided in accordance with 5.7.2.6 	Yes	
9.11	5.7.2.8	<ul style="list-style-type: none"> Earthing terminal provided on withdrawable parts for earth continuity testing 	Yes	
10	5.8	Padlocking facilities		
10.1	5.8.1	<ul style="list-style-type: none"> Facilities provided to padlock the following. - all orifice shutters individually in the closed position, 	Yes	

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10.2		- the circuit-breaker in each of the service, test/disconnected and (where applicable) earthing positions,	Yes	
10.3		- integral earthing switches in both the open and earthing positions (where applicable), and	N/A	
10.4		- the mechanical tripping device in the case where the circuit-breaker is used for earthing	N/A	
10.5	5.8.2	• Padlocking facility shackle diameter mm	>6	
11	5.9	Stand-off hand-held remote control unit for switching of circuit-breakers (circuit-breaker panels and VT panels - where applicable)		
11.1	5.9.1	• Stand-off hand-held remote control unit supplied with switchboard	Yes	
11.2	5.9.2	• Minimum length of lead (umbilical cord) m	20	
11.3	5.9.3	• Control box fitted with push-buttons in accordance with 5.9.3	Yes	
11.4	5.9.4	• Control box IP rating IP	IP67	
11.5	5.9.5	• Type of female receptacle (circular panel connector with self-retaining bayonet coupling) to be supplied	ITT CANNON type CA 3102 A 14S-2 (or equiv)	
11.6	5.9.6	• Location of female receptacle	LV Compartment door - front	
11.7	5.9.7	• TRIP control function pins	C and D	
11.8	5.9.7	• CLOSE control function pins	A and B	
11.9	5.9.8	• Circuit-breaker mechanical CLOSE button on compartment door disabled	Yes	
12	5.10	Racking operation and motorised racking devices for withdrawable parts		
12.1	5.10.1	• Transfer of withdrawable parts to and from the service position only possible when the compartment door is closed	Yes	
12.2	5.10.2	• Interlock system for compartments doors to prevent the withdrawal or engagement of the withdrawable part when the door is open	Yes	
12.3	5.10.3	• Type of motorised racking device offered	Integral (internal) / external	

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12.4	5.10.4	• Continuous power rating of motorised racking device	W	≤ 100	
12.5	5.10.4	• Total racking time	s	xxxxxxxxxx	
12.6	5.10.6	• Number of tested mechanical operations using motorised racking device		SANS 62271-200 6.10.2.1	
12.7	5.10.7	• Motorised racking device supplied with hand-held remote control unit for remote operation		Yes	
12.8	5.10.8	• Type of female receptacle (circular panel connector with bayonet coupling) to be supplied		ITT CANNON type CA 3102 A 14S-2 (or equiv)	
12.9	5.10.9	• Location of female receptacle for hand-held remote control unit (integral motorised racking device)		LV Compartment door - front	
12.10	5.10.9	• RACK-OUT control function	pins	C and D	
12.11	5.10.9	• RACK-IN control function	pins	A and B	
	5.10.12	□ Circuit breaker interlocked to prevent rack in or out in closed position		Yes	
13	5.11	Switchboard physical design			
13.1	5.11.1.2	• Switchroom and cable trench design		D-DT-5238	
13.2	5.11.1.3	• Operation of switchgear		Front	
13.3	5.11.1.4	• Panel fronts fully aligned		Yes	
13.4	5.11.1.5	• Access to cable compartment		Rear	
13.5	5.11.1.6	• Suitable for future extensions on both sides of the switchboard		Yes	
13.6		□ Joggle chamber width (if used)	mm	xxxxxxxxxx	
13.7		□ Outline drawing of joggle chamber required		Yes	
13.8	5.11.1.9	• Interchangeability of circuit-breakers in existing switchboard (main and control circuits)		Only with circuit-breakers rated equivalent or lower	
13.9	5.11.1.10	• All doors equipped with travel stops		Yes	
13.10	5.11.1.8	• Overall panel dimensions			
		□ - Width	mm	xxxxxxxxxx	
13.11	5.11.1.8	□ - Depth (front to rear)	mm	xxxxxxxxxx	

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13 12	5 11 1.8	<input type="checkbox"/> - Height	mm	xxxxxxxxxx	
13 13	5 11 1.8	<input type="checkbox"/> - rear of panel to centre of LV control cable gland plate	mm	xxxxxxxxxx	
13 14	5 11.1.8	<input type="checkbox"/> - distance (clearance) required from pressure relief flaps to ceiling (min)	mm	xxxxxxxxxx	
13.15	5 11 1.8	<input type="checkbox"/> - distance (clearance) required in front of the switchgear panel for removing removable parts, VT or CPAT (min)	mm	xxxxxxxxxx	
13.16	5 11 1.8	<input type="checkbox"/> - distance (clearance) required to the rear switch room wall (min)	mm	xxxxxxxxxx	
13.17	5.11 1.8	<input type="checkbox"/> - cable trench width required (min)	mm	xxxxxxxxxx	
13 18	5.11 1.8	<input type="checkbox"/> - cable trench over-hang required for cable terminations (min)	mm	xxxxxxxxxx	
13 19		<input type="checkbox"/> Withdrawable part dimensions			
13 20		<input type="checkbox"/> - Width	mm	xxxxxxxxxx	
13 21		<input type="checkbox"/> - Depth	mm	xxxxxxxxxx	
		<input type="checkbox"/> - Height	mm	xxxxxxxxxx	
	5.11 2	<input type="checkbox"/> LV Compartment			
13 22	5 11.2.1	<input type="checkbox"/> Location of LV compartment		Front	
13 23	5 11.2.2	<input type="checkbox"/> Top entry removable brass/aluminium LV gland plates provided with holes and knock-outs/grommets		Yes	
13 24	5 11.2.4	<input type="checkbox"/> Protection and control scheme location			
	5 11 3	<input type="checkbox"/> Degrees of protection of enclosures			
13.25		<input type="checkbox"/> - Moving parts	IP	IP2X	
13 26		<input type="checkbox"/> - Live parts	IP	IP3X	
13 27		<input type="checkbox"/> - cable boxes	IP	IP3X	
	5 11.4	<input type="checkbox"/> Corrosion protection of metal enclosures and busbars			
13 28	5 11 4.1	<input type="checkbox"/> - Detailed specification number (DSP 34-1658)	DS	xxxxxxxxxx	
13 29	5 11 4.2	<input type="checkbox"/> - Corrosion protection system applied for all joints and tees in busbars and busbar connections		xxxxxxxxxx	
13.30	5.11 4.3	<input type="checkbox"/> - Corrosion protection system applied for all bolts, nuts and washers		xxxxxxxxxx	
13 31	5 11 4.4	<input type="checkbox"/> - Corrosion protection system applied for all earthing bars		Tinned / Silverised	
	5.11 5	<input type="checkbox"/> Transporting device for removable parts			
13 32	5.11 5.2	<input type="checkbox"/> - Type of transporting device		Integral floor racking carriage(truck) / External trolley	

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			(cassette type CB)	
13 33	5 11 5 3	<input type="checkbox"/> - facilities for height adjustment and alignment provided (external trolley offered for cassette type CB)	Yes	
13.34	5 11.5. 4	<input type="checkbox"/> - racking floor plates provided (integral floor racking carriage / truck offered)	Yes	
13 35	5 11 5 4	<input type="checkbox"/> - material offered for racking floor plates (integral floor racking carriage / truck offered) mm	Galv Steel / 3CR12 - 3 mm	
13 36	5 11 5 5	<input type="checkbox"/> - permanent fixture (uni-struts / frame / support) for proper levelling of the panels provided (integral floor racking carriage / truck offered)	Yes	
13 37	5 11 5 5	<input type="checkbox"/> - spacing (i.e. front to rear) between panel fixing centres mm	xxxxxxxxxx	
13 38	5 11 5 5	<input type="checkbox"/> - material offered for permanent fixture (integral floor racking carriage / truck offered)	xxxxxxxxxx	
		<input type="checkbox"/>		
14	5 12	Insulation requirements for live conductors in air		
	5.12.1	<ul style="list-style-type: none"> Insulation and clearance requirements 		
14 1	5 12 1. 1 / 5.12.1. 2	<input type="checkbox"/> - Clearances designed for type 1 (bare) or type 2 (shrouded/covered) conductors (NRS 012)	Type 1 / Type 2	
14 2	5 12 1 3	<input type="checkbox"/> - Material offered for shrouding / covering of live conductors (if applicable)	Heat-shrink tubes/tapes / Clip-on pre-moulded covers	
14 3	5 12 1 4	<input type="checkbox"/> - material comparative tracking index (CTI) offered where applicable OR	> 400	
	5 12 1 4	<input type="checkbox"/> - tracking and erosion classification of the material in accordance of IEC 60587 Class	xxxxxxxxxx	
14.4	5 12 1 5	<input type="checkbox"/> - Material offered for non-metallic flash-barriers (if applicable)	xxxxxxxxxx	
	5 12 2	<ul style="list-style-type: none"> Creepage distances 		
14 5		<input type="checkbox"/> - Actual minimum creepage distance offered (USCD) mm/kV	34,7 mm/kV	
	5.12.3	<ul style="list-style-type: none"> Bushings and insulators 		
14 6	5 12 3 1	<input type="checkbox"/> - Bushing type connections offered where withdrawable parts are	Yes	

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		connected to busbars		
14.7	5 12 3 2	<input type="checkbox"/> - Bushings and insulators to comply with NRS 012	Yes	
14 8	5 12.3. 3	<input type="checkbox"/> - Bushings and insulators partial discharge tested to SANS 60270	Yes	
14 9	5.12.4	• Bus-section segregation <input type="checkbox"/> - Method offered for bus-section segregation	xxxxxxxxxx	
14 10	5 12 4	• Segregation (partitioning) offered between adjacent panel busbar compartments <input type="checkbox"/>	xxxxxxxxxx	
15	5 13	Provisions for power cable terminations (where applicable)		
15 1	5 13 1	• Type of cable terminations to NRS 012	Type 2 (shrouded heat-shrink)	xxxxxxxxxx
15 2	5 13 2	• Cable compartment design and construction to NRS 012	Yes	
15 3	5 13 3	• Number of individual terminal fixing points per phase (excluding surge arresters - if applicable)	_____	
15 4	5.13 4	• Number and type of cables to be terminated	_____	
15 5	5 13 5 / 5 13.6	• Fastening equipment (set screw, nut and washers) supplied for each terminal fixing point	M16	
15 6	5 13 8 / 5 13 13	• Number of individual cable support clamps (D-DT-8019) and rubber grommets (D-DT-8027) per phase	_____	
15 7	5 13 10	• Clearance distance from the cable support clamp to the terminal fixing centre line mm	_____	
15.8	5 13 11	• Vermin proofing plate thickness offered (min) mm	2	
15 9	5 13 11	• Vermin proofing plate material offered	Al / slotted steel	
15 10	5 13 15	• Copper earthing bar provided in cable compartment in accordance with 5.13 15 <input type="checkbox"/>	Yes	
16	5 14	Provisions of surge arresters (where applicable)		
16 1	5 14.1	• Location of surge arresters	Cable compartment	xxxxxxxxxx
	5 14 1	• Details of surge arresters offered		
16 2		<input type="checkbox"/> - make	xxxxxxxxxx	
16 3		<input type="checkbox"/> - product code (type)	xxxxxxxxxx	

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16 4		<input type="checkbox"/> - type (indoor shrouded (type 2) / outdoor bare (type 1))	xxxxxxxxxx	
16.5		<input type="checkbox"/> - line discharge class (SANS 60099-4)	xxxxxxxxxx	
16 6		<input type="checkbox"/> - nominal 8/20 μ s discharge current (I_n) - peak	kA 10	
16 7		<input type="checkbox"/> - rated voltage (U_r)	kV xxxxxxxxxxxx	
16 7		<input type="checkbox"/> - maximum continuous operating voltage (MCOV)	kV xxxxxxxxxxxx	
16.8		<input type="checkbox"/> - maximum residual voltage (V_{res}) @ I_n - peak	kV xxxxxxxxxxxx	
16.9		<input type="checkbox"/> - creepage distance - minimum	mm	
16 10		<input type="checkbox"/> - data sheet attached	Yes	
16 11	5 14 2	• Separate point of attachment provided for each surge arrester	Yes	
16 12	5 14.3	• Cross section area of surge arrester lead (min)	mm ² 16	
16 13	5 14.4	• Cross section dimensions of surge arrester common earthing bar (min)	mm	
16 14	5 14.4	• Type of earthing conductor used to earth surge arresters to main earthing bar	Cu bar / stranded flexible conductor	
16 15	5 14 4	• Size of earthing conductor used to earth surge arresters to main earthing bar (min)	mm ² 70	
		<input type="checkbox"/>		
17	5 15	Compartment heaters		
	5 15 1	• Heater size offered		
17 1		<input type="checkbox"/> - busbar compartment	Watt xxxxxxxxxxxx	
17 2		<input type="checkbox"/> - circuit-breaker compartment (where applicable)	Watt xxxxxxxxxxxx	
17 3		<input type="checkbox"/> - cable compartment (where applicable)	Watt xxxxxxxxxxxx	
17.4	5.15.3	• Heat resistant lead insulating material offered	xxxxxxxxxx	
17 5	5 15 5	• Heater control circuits to 240-56063705 and D-DT-5408	Yes	
		<input type="checkbox"/>		
18	5.16	Position / status indication		
	5 16 1	• Position / status indicators on the LV compartment door (off-board protection schemes only)		
18 1	1	<input type="checkbox"/> - circuit-breaker contact status (open/closed)	Yes	
18 2		<input type="checkbox"/> - circuit-breaker racked in/out status (service position/test position)	Yes	
18 3		<input type="checkbox"/> - earthing switch applied status (open/closed)	Yes	

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18 4	5 16 1.2	<input type="checkbox"/> - LED indicators with lamp-check push-button provided	Yes	
18 5	5 16 2	• Cable live indication provided on LV compartment door	SANS 61243-5	
	5 16.3 1	• Circuit-breaker and earthing switch mechanical position indication		
18 6		<input type="checkbox"/> - Closed position "I" in white lettering on a red background	Yes	
18 7		<input type="checkbox"/> - Open position "O" in white lettering on a green background	Yes	
18 8		<input type="checkbox"/> - Earthed position (the earth symbol) in black on a yellow background	Yes	
18 9	5.16 3 3	• Closing spring status indicated by "SPRING CHARGED" and "SPRING DISCHARGED"	Yes	
18 10	5 16.3 4	• Type of non-resettable circuit-breaker operation counter offered	Mechanical / electrical	
18 11	5 16 3 5	• Position / status indicators visible through compartment door	Yes	
		<input type="checkbox"/>		
19	5 17	Labels and colour coding		
19.1	5 17 1 2	• Labels manufactured to DSP 34-1513 and D-DT-5049 (unless otherwise specified or agreed)	Yes	
		• Warning labels		
19 2	5.17 2 1	<input type="checkbox"/> - Signal red busbar shutters with "BUSBAR"	Yes	
19 3	5 17.2 2	<input type="checkbox"/> - White arrows indicating left and right busbars for bus-section panels	N/A	
19 4	5.17 2 3	<input type="checkbox"/> - Canary yellow cable shutters with "CABLE"	Yes	
19 5	5 17 2 4	<input type="checkbox"/> - "NO STEP" on top of panels	Yes	
19 6	5 17 2 5	<input type="checkbox"/> - Busbar blanking plates labelled "BUSBAR - DO NOT REMOVE" on ends of switchboard	Yes	
	5 17 3	• Main circuit and switchboard designation labels		
19 7	5 17 3 3/4	<input type="checkbox"/> - Labels provided for all panels and busbar sections	Yes	
19 8		<input type="checkbox"/> - Width (min) mm	> 300	
19.9		<input type="checkbox"/> - Height (min) mm	> 50	
19 10	5 17.3. 3	<input type="checkbox"/> - Main circuit designation label positions	Front and rear of panels (not on removable doors/cover s)	
19 11	5 17 3 4	<input type="checkbox"/> - Label provided for switchboard	Yes	

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19.12		<input type="checkbox"/> - Width (min.)	mm	> 400	
19.13		<input type="checkbox"/> - Height (min)	mm	> 50	
19.14	5.17.3.4	<input type="checkbox"/> - Switchboard designation label position		Front (not on removable doors)	
	5.17.4	• Operating labels			
19.15	5.17.4.1	<input type="checkbox"/> - Instructions for mechanically tripping and closing the circuit-breaker		Yes	
19.16	5.17.4.1	<input type="checkbox"/> - Instructions for opening and closing the earthing switch		N/A	
19.17	5.17.4.1	<input type="checkbox"/> - Instructions for charging closing spring		Yes	
19.18	5.17.4.2	<input type="checkbox"/> - Actuator(s) for local opening and closing of the circuit-breaker		Yes	
19.19	5.17.4.3	<input type="checkbox"/> - Stand-off remote control unit push buttons		Yes	
19.20	5.17.4.4/5	<input type="checkbox"/> - Compartment doors (interlock controlled)		Yes	
19.21	5.17.4.6	<input type="checkbox"/> - Switchgear tool cabinet		Yes	
	5.17.5	• Function labels			
19.22	5.17.5.1	<input type="checkbox"/> - Function labels provided to identify all LV equipment		Yes	
19.23	5.17.5.2	<input type="checkbox"/> - Function label text height (min)	mm	> 5	
	5.17.6	• Panel colour coding			
19.24	5.17.6.1	<input type="checkbox"/> - Panel			
19.25	5.17.6.2	<input type="checkbox"/> - Removable busbar compartment covers		Signal red	
19.26	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	• Dry type current transformers to SANS 60044-1		Yes	
20.2	5.18.1	• Make (manufacturer) of CT offered		xxxxxxxxxx	
20.3	5.18.1	• Type of CT offered (ring-type / ring bar & base / wound-primary / post-type / etc)		xxxxxxxxxx	
20.4	5.18.2	• CT specification (drawing number)		D-DT-5408	
20.5	4.7	• Rated short-time withstand current	kA		
20.6	5.18.2	• Position relative to the circuit-breaker		Cable side	
20.7	5.18.3	• Terminal numbering		D-DT-5408	
		• 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	

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20 10	5 18 2	<input type="checkbox"/> c) ratios	A	_____	
		• 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	_____	
		<input type="checkbox"/>			
21	5 19	Voltage Transformers and Control Power Transformers (see D-DT-5408) (where applicable)			
21 1	5 19 1	• Withdrawable design in separate dedicated panel		N/A	
21.2	5 19 2	• Dry type voltage transformers to SANS 60044-2		N/A	
21 3	5 19.2	• Make (manufacturer) of VT/CPAT offered		N/A	
21.4	5 19 3	• Dry type control power transformers to SANS 60076		N/A	
21.5	5 19 4	• VT and CPAT specification (drawing number)		N/A	
21.6	5 19 6	• Primary fuse protection to SANS 60282-1		N/A	
	5 19 6	• Details and ratings of fuses offered			
21 7	5 19 6	<input type="checkbox"/> a) make (manufacturer)		N/A	
21.8	5 19.6	<input type="checkbox"/> b) type designation (SANS 60282-1)		N/A	
21 9	5.19 6	<input type="checkbox"/> c) rated voltage	kV	N/A	
21 10	5 19.6	<input type="checkbox"/> d) rated current	A	N/A	
21 11	5 19 6	<input type="checkbox"/> e) rated maximum breaking current	kA	N/A	
21.12	5 19.6	<input type="checkbox"/> f) class (SANS 60282-1)		N/A	
21 13	5.19 7	• Terminal numbering		N/A	
		• Voltage transformers.			
21 14	5 19 4	<input type="checkbox"/> a) ratio		N/A	
21 15	5 19 4	<input type="checkbox"/> b) class		N/A	
21.16	5 19.4	<input type="checkbox"/> c) burden	VA	N/A	
21 17	5 19 4	<input type="checkbox"/> d) voltage factor		N/A	
21 18	5 19 4	<input type="checkbox"/> e) core construction	VA	N/A	
		• Control power transformers.			
21.19	5 19.4	<input type="checkbox"/> a) ratio		N/A	
21 20	5 19 4	<input type="checkbox"/> b) vector		N/A	
21 21	5 19 4	<input type="checkbox"/> c) continuous power	VA	N/A	
		<input type="checkbox"/>			
22	5 20	Auxiliary and control circuits (see 240-56063705 / D-DT-5408)			

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22.1	5 20 1	• Auxiliary and control circuits to 240-56063705 and D-DT-5408		Yes	
22.2		• Auxiliary power supplies		On site by Eskom	
22.3		<input type="checkbox"/> - Provision			
22.3		<input type="checkbox"/> - Peak power requirement/panel (max)	VA	xxxxxxxxxx	
22.4		<input type="checkbox"/> - Standby power requirements/panel	VA	xxxxxxxxxx	
22.5		• 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	xxxxxxxxxx	
22.7		<input type="checkbox"/> - d.c. power (continuous)	W	≤ 100	
22.8		<input type="checkbox"/> - total time taken to charge spring	s	xxxxxxxxxx	
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	
22.12		• Motorised racking device 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 rack withdrawable part	s	xxxxxxxxxx	
22.16		<input type="checkbox"/> - method offered for protection against continual motor running (over-run)		xxxxxxxxxx	
22.17		• 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	
22.22		• 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	

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22.30	• Circuit-breaker equipped with anti-pumping circuitry	Yes	
22.31	• Circuit-breaker control circuit interlocks provided in accordance with DST 34-1692	Yes	
22.32	• Circuit-breaker alarm circuits provided and wired in accordance with DST 34-1692 and D-DT-5408	Yes	
	• Auxiliary contacts provided (spare for Eskom use)		
22.33	<input type="checkbox"/> Duty rating		
22.34	<input type="checkbox"/> - a.c. and d.c. supply current A	10	
	<input type="checkbox"/> - N/O and N/C contact reference positions	Circuit-breaker opened, spring discharged, busbar and cable earthing switches not applied, circuit-breaker in service position	
	<input type="checkbox"/> Alarm SF ₆ contacts (incl. bus-section circuit-breaker)		
22.35	<input type="checkbox"/> - N/O	N/A	
22.36	<input type="checkbox"/> - N/C	N/A	
	<input type="checkbox"/> Block operation-SF ₆ contacts (incl. bus-section circuit-breaker)		
22.37	<input type="checkbox"/> - N/O	N/A	
22.38	<input type="checkbox"/> - N/C	N/A	
	<input type="checkbox"/> Circuit-breaker auxiliary switch contacts		
22.39	<input type="checkbox"/> - N/O	4	
22.40	<input type="checkbox"/> - N/C	4	
	<input type="checkbox"/> Circuit-breaker spring limit switch contacts		
22.41	<input type="checkbox"/> - N/O	2	
22.42	<input type="checkbox"/> - N/C	2	
	<input type="checkbox"/> Cable earthed (incomer/feeder panels only)		
22.43	<input type="checkbox"/> - N/O	1	
22.44	<input type="checkbox"/> - N/C	0	
	<input type="checkbox"/> Busbar earthed status indication (incomer panels only)		
22.45	<input type="checkbox"/> - N/O	N/A	
22.46	<input type="checkbox"/> - N/C	N/A	
	<input type="checkbox"/> Circuit-breaker racked out		

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22 47	<input type="checkbox"/> - N/O	1	
22.48	<input type="checkbox"/> Circuit-breaker racked in	1	
22.49	<input type="checkbox"/> - N/C	N/A	
	<input type="checkbox"/> VT racked in (VT panels only)		
	<input type="checkbox"/> - N/C	N/A	
22 50	<input type="checkbox"/> Busbar earthed indications (VT panels only)		
	<input type="checkbox"/> - N/O	N/A	
22 51	• Terminal blocks and terminal strips		
22.52	<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 53	<input type="checkbox"/> - Terminal block width offered mm	≥ 8	
22 54	<input type="checkbox"/> - Make of terminal block offered	xxxxxxxxxx	
22 55	• Lugs (insulated hook blade type)	Crimped	
22 56	• Earth sliding link types/equivalents	Weidmuller TVP SAKA 10	
22 57	• Trunking provided at top and bottom of each terminal rail	Yes	
22 58	• 'Fine-tooth' trunking tooth width mm	6,1	
22 59	• Trunking size mm	60 x 60	
	• Wiring size		
22 60	<input type="checkbox"/> - CT, VT, CPAT and motor control circuit wires mm ²	2,5	
22.61	<input type="checkbox"/> - Control and other auxiliary wires mm ²	1,5	
22 62	<input type="checkbox"/> - Minimum number of strands	7	
	• Wiring colour		
22.63	<input type="checkbox"/> - CT, VT and CPAT wires	red/white/blue/black	
22.64	<input type="checkbox"/> - Earth wires	green/yellow	
22 65	<input type="checkbox"/> - All other wires	grey	
22 66	• Wiring identification	Ferruling	
22.67	• Terminal strips in accordance with table 1 of 240-56063705- located in LV compartment	Yes	
	• LV MCBs		
22 68	<input type="checkbox"/> - MCBs to SANS 60947-2 and IEC 60898	Yes	
22 69	<input type="checkbox"/> - Make and type offered	xxxxxxxxxx	
22 70	<input type="checkbox"/> - I _{cu} kA	xxxxxxxxxx	
22 71	<input type="checkbox"/> - I _{cs} kA	xxxxxxxxxx	
22 72	<input type="checkbox"/> - Utilisation category (SANS 60947-2)	'A'	
22.73	<input type="checkbox"/> - Max service voltage VA	xxxxxxxxxx	
22 74	<input type="checkbox"/> - d c MCB rated voltage V	≥ 125	
22.75	<input type="checkbox"/> - Pollution degree (SANS 60947-2)	≥ 3	
22 76	<input type="checkbox"/> - Suitable for isolation (SANS 60947-2)	Yes	

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22.77		<input type="checkbox"/> - Protection curve (SANS 60947-2 / IEC 60898)	'C'	
22.78		<input type="checkbox"/> - Location	LV compartment	
22.79		• LV Fuses		
22.80		<input type="checkbox"/> - LV fuses to SANS 60269-2	Yes	
22.81		<input type="checkbox"/> - LV fuse system offered (SANS 60269-2)	G	
22.82		<input type="checkbox"/> - LV fuse size offered (SANS 60269-2)	E1	
22.83		<input type="checkbox"/> - Utilisation category	gG	
		<input type="checkbox"/> - Make and type offered	xxxxxxxxxx	
		<input type="checkbox"/>		
23	5.21	Arc detection protection system equipment (see 240-56063705/ D-DT-5408)		
23.1	5.21.1	• Provision for the fitment of arc detection protection system equipment in accordance with DSP 34-306	Yes	
23.2	5.21.2	• Arc sensors to be fitted in the following		
23.3		<input type="checkbox"/> - busbar-compartment	Yes	
23.4		<input type="checkbox"/> - circuit-breaker / VT / CPAT compartment	Yes	
23.5		<input type="checkbox"/> - cable compartment (where applicable)	Yes	
23.6	5.21.2	• Arc sensors to be fitted and wired to slave relays	Yes	
23.7	5.21.2	• Make and type of arc detection protection system equipment	_____	
23.8	5.21.2	• Supplier of arc detection protection system equipment	_____	
		• Schematic of the arc detection protection system to be produced for each switchboard	Yes	
		<input type="checkbox"/>		
24	5.22	Nameplates		
24.1	5.22.1	• Nameplates provided for the following		
24.2	5.22.2	<input type="checkbox"/> - switchgear panel (SANS 62271-200)	Yes	
24.3	5.22.2	<input type="checkbox"/> - circuit-breaker (SANS 62271-100) - where applicable	Yes	
24.4	5.22.3	<input type="checkbox"/> - CT (SANS 60044-1) - where applicable	Yes	
24.5	5.22.3	<input type="checkbox"/> - VT (SANS 60044-2) - where applicable	N/A	
24.6	5.22.3	<input type="checkbox"/> - CPAT (SANS 60076) - where applicable	N/A	
24.7	5.22.5/6	• Duplicate nameplates provided in LV compartment for circuit-breaker, CTs,	Yes	

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		VT, CPAT - where applicable		
24.7	5 22 8	<ul style="list-style-type: none"> • Namplate material offered 	xxxxxxxxxx	
		<input type="checkbox"/>		
25	5 23 / 8 3	Tools and spares		
		<ul style="list-style-type: none"> • Tools to be supplied with switchboard (minimum requirements). 		
25 1	5 23 1	<ul style="list-style-type: none"> - full set of operating tools (provide list on separate sheet provided) 	Sets	1 set per switchboard
25.2	5 23 2	<ul style="list-style-type: none"> - hand-held remote control unit 	EA	1 per switchboard
25 3	5.23 3	<ul style="list-style-type: none"> - externally mounted motorised racking device - where applicable 	EA	1 per switchboard
25 4	5 23 4	<ul style="list-style-type: none"> - external transporting device - where applicable 	EA	1 per bus-section and panel size
25 5	5 23 5	<ul style="list-style-type: none"> - wall-mounted steel tool cabinet 	EA	1 per switchboard
25 6	5.23 6	<ul style="list-style-type: none"> • Standard tools available for minor maintenance (provide list on separate sheet provided) 		Yes
25.7	5 23.7	<ul style="list-style-type: none"> • Specialised tools available for major maintenance purposes (provide list on separate sheet provided) 		Yes
25.8	5 23.8 / 8.3	<ul style="list-style-type: none"> • Spares available for maintenance (provide list on separate sheet provided) 		Yes
		<ul style="list-style-type: none"> • Spares to be supplied with switchboard (where applicable) 		
25 9	5 23 9 / 8 3	<ul style="list-style-type: none"> - Trip coils & close coils 	Sets	2 of each per switchboard
		<input type="checkbox"/>		
26	5 24	Documentation		
		Note: All tender documentation to be provided in electronic format.		
	5 24 1	<ul style="list-style-type: none"> • Documentation to be supplied with tender 		
26 1		<ul style="list-style-type: none"> - GA drawing per panel type (provide drawing number on separate sheet provided) 	Sets	1
26 2		<ul style="list-style-type: none"> - Generic layout of nameplates (provide drawing number on separate sheet provided) 	Sets	1
26 3		<ul style="list-style-type: none"> - Generic auxiliary and control circuit schematic wiring diagrams for each panel type 	Sets	1
26.4		<ul style="list-style-type: none"> - list of all operating tools for each type of switchgear panel offered (provide list on separate sheet 	Sets	1

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		provided)		
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
26 11		<input type="checkbox"/> - training material	Sets	1
26.12		<input type="checkbox"/> - all other relevant additional information requested	Sets	1
	5 24.2	• 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		• Units used in Republic of South Africa		In tender/offer
26 18		• Project reference list, service to Eskom		In tender/offer
		<input type="checkbox"/>		
27		Miscellaneous		
		• 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	5 25	<input type="checkbox"/> Packaging in accordance with DSP 34-1157	Y/N	Yes
28	10	Training Requirements		

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28.1		<ul style="list-style-type: none"> Training offered in accordance with DSP 34-2207 	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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