Eskom	Standard	Technology

Title: **SPECIFICATION FOR MEDIUM VOLTAGE MINIATURE SUBSTATIONS FOR SYSTEMS WITH NOMINAL VOLTAGES OF 3.3 KV, 6.6 KV, 11 KV AND 22 KV STANDARD**

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Compiled by

Sandisiwe Mtshaulana/ Neville Booyens

Engineer GOUSI/ Chief Engineer DTE

Date: 2026/08/20

Approved by

Jacques Paulse

Chairperson MV/LV Cable System Care Group

Date: 2026/08/25

Authorized by

Lerato Lekhema

Senior Manager: DTE

Date: 26/08/2026

Supported by SCOT/SC

Neville Booyens

CS&MES SC Chairperson

Date: 2026/08/26

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SCOT Study Committee Number/Name: **Cable Systems and Metal Enclosed Switchgear**

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1 Introduction

The requirements and specifications for medium-voltage miniature substations for systems with nominal voltages of 3.3 kV, 6.6 kV, 11 kV and 22 kV in this standard are based on SANS 1029, Mini-substations for rated A.C. voltages up to and including 24 kV.

This standard has been prepared on behalf of the Steering Committee of Technologies (SCOT). It has been approved by the committee for use by Eskom as a requirement standard for the manufacturing and procurement of miniature substations for medium-voltage systems with nominal voltages from 3.3 kV up to and including 22 kV.

2 Supporting clauses

2.1 Scope

This standard covers the Eskom's minimum requirements for the selection, manufacturing, testing and supply of outdoor type miniature substations. It is applicable to medium voltage pre-fabricated MV/LV substations for systems with A.C. rated nominal voltages from 3.3 kV up to and including 22 kV. The standard covers both Type A and Type B mini-subs up to and including a power rating of 1000 kVA and mini-subs for coastal applications.

The requirements for miniature substations are based on SANS 1029 and this document.

Note: A decision was taken to standardise on coastal design for both inland and coastal applications.

2.1.1 Purpose

The document specifies the technical requirements for miniature substations to be supplied to Eskom.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions.

2.2 Normative/Informative references

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

2.2.1 Normative

[1] ISO 9001: Quality Management Systems.

[2] 240-56364491 (DST 34-462): Standard design for distribution protection schemes.

[3] 240-56030406: Specification for ring main units for systems with nominal voltages from 3.3 kV to 33 kV;

[4] DSP_34-1080: Specification for fault path indicators for cable and overhead line networks up to 132kV;240-75661431 Specification for mineral insulating oils (uninhibited and Inhibited)-Purchase, management, maintenance and testing;

[5] 240-170000721: Technical clarifications associated with 240-56030406 RMU specification revision 2;

[6] 240-75655504: Corrosion protection standard for new indoor and outdoor Eskom equipment, components, materials and structures manufactured from steel standard;

[7] 240-64685228 (DST 34-333): Generic specification for protective intelligent electronic devices (IEDS);

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[8] 240-45395762: Specific requirements for distribution pole and ground-mounted transformers up to 33 kV and 1 MVA;

[9] 240-70413291 (DSP 34-253): Specification for electrical terminal blocks;

[10] 240-124520996: Switchgear training requirements from original equipment manufacturers standard;

[11] 240-57648800: New oil filled auxiliary transformers rated 1 MVA and below and 33 kV and below;

[12] SANS 1029, Mini-substations for rated AC voltages up to and including 24 kV;

[13] SANS 780, Distribution transformers;

[14] SANS 1874, Switchgear — Metal-enclosed ring main units for rated AC voltages above 1 kV and up to and including 36 kV;

[15] SANS 876, Cable terminations and live conductors within air-filled enclosures (insulation coordination) for rated AC voltages from 7,2 kV and up to and including 36 kV;

[16] SANS 1332, Accessories for medium-voltage power cables (3,8/6,6 kV to 19/33 kV);

[17] SANS 121 / ISO 1461, Hot-dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods;

[18] SANS 1019, Standard voltages, currents and insulation levels for electricity supply;

[19] SANS 1091, National colour standard;

[20] SANS 60076-7, Power transformers – Part 7: Loading guide for oil-immersed power transformers;

[21] SANS 60269-2, Low-voltage fuses – Part 2: Supplementary requirements for fuses for use by authorized persons (fuses mainly for industrial application) - Examples of standardized systems of fuses A to I;

[22] SANS 60529, Degrees of protection provided by enclosures (IP Code);

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

[24] SANS 60947-3, Low-voltage switchgear and controlgear – Part 3: Switches, disconnectors, switch-disconnectors and fuse-combination units;

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

[26] SANS 61439-1, Low-voltage switchgear and controlgear assemblies – Part 1: General rules;

[27] SANS 61869-2, Instrument transformers Part 2: Additional requirements for current transformers;

[28] SANS 62271-202, High-voltage switchgear and controlgear - Part 202: High-voltage/low-voltage prefabricated substation;

[29] 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;

[30] D-DT-0859, Type B mini-substation plinth details;

[31] D-DT-0860, 11 kV and 22 kV Type A mini-sub cable termination detail;

[32] D-DT-0868, Schematic and wiring diagram;

[33] D-DT-1013, Mini-sub meter plate details;

[34] D-DT-3034, LV circuit breakers;

[35] D-DT-3088, Distribution transformer LV neutral surge arrester;

[36] D-DT-3132, Wire, meter sealing s/steel, Ferrule, tinned Cu sealing 12mm LG;

[37] D-DT-3181, LV fuses;

[38] D-DT-3409, Fuse holder, vertical 3P 440V;

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[39] D-DT-3202, Danger sign (unauthorised entry prohibited);

[40] D-DT-6073, Signs D & E (Treatment and Full First Aid Instructions);

[41] D-DT-8017, Screened separable connectors (22kV);

[42] D-DT-8019, Cable Clamp (black polypropylene);

[43] D-DT-8029, Sealant strip for mini-sub/ RMU;

[44] D-DT-8050, Mini-substation 11 kV, Type B;

[45] D-DT-8051, Mini-substation 22 kV, Type B;

[46] D-DT-8052, Mini-substation 11 kV, Type A; and

[47] D-DT-8053, Mini-substation 22 kV, Type A

Informative

None

2.3 Definitions

2.3.1 General

The definitions given in SANS 1029, IEV and the following shall apply.

Definition	Description
Nominal voltage	The stated r.m.s. phase-to-phase voltage of the supply to which equipment is connected.
Rated voltage	The highest r.m.s. phase-to-phase voltage of the supply for which equipment is designed to operate continuously.
Ring main unit	A medium voltage metal-enclosed switchgear assembly that comprises a combination of two ring switch-disconnectors and a circuit-breaker tee-off function. These functions incorporate integral cable earthing switches and have facilities for cable testing.
Type A mini-sub	A miniature substation that is fitted with an arrangement for off-load, dead-break isolation or disconnection in the MV compartment, that consists of screened separable connectors for 11 kV and 22 kV.
Type B mini-sub	A miniature substation that is equipped with a ring main unit in the MV compartment.

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
EFI	Earth Fault Indicator
CT	Current Transformer
IED	Intelligent Electronic Device
CB	Circuit Breaker
VDS	Voltage Detecting System
SSC	Screened Separable Connector

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Abbreviation	Description
OEM	Original Equipment manufacturer
RFID	Radio Frequency Identification
CBCT	Core Balance Current Transformer
Mini-sub	Miniature Substation
RMU	Ring main unit
RTU	Remote Terminal Unit
CCAA	Copper Cladded Aluminium Alloy

2.5 Roles and responsibilities

All Eskom employees and/or appointed bodies involved in the procurement of mini subs and/or the associated accessories shall ensure that the product meets the requirements as specified in this document. Any deviation from these requirements shall constitute non-conformance, unless it was agreed to by a delegated cable system and miniature substation equipment specialist and is based on sound engineering judgement at the time of tender evaluations or after tender award.

2.6 Process for monitoring

The mini sub acceptance shall be based on the relevant technical evaluation criteria at the time of tender and based on factory acceptance testing requirements as per this standard.

2.7 Related/supporting documents

Refer to clause/ section 2.2.

3. Miniature substation requirements

3.1 General requirements for miniature substations

a) Mini-subs shall be manufactured in accordance with SANS 1029 and the requirements of this standard. Where conflicting requirements with the relevant SANS specifications occur; this standard shall take precedence. Nothing in this standard shall lessen the obligations of the supplier;

b) The supplier shall be fully responsible for the design and its satisfactory performance in service. Approval or acceptance by Eskom shall not relieve the supplier of the responsibility for the adequacy of the design; and

c) This standard covers the requirements for both Type A and Type B mini-subs up to and including a maximum power rating of 1000 kVA.

3.1.1 Standard operating conditions

a) In addition to the requirements of SANS 1029; the mini-sub units shall be suitable for operation under the following service conditions:

1) Pollution level: “very heavy” for coastal (corrosive) and inland applications. Pollution conditions inside the mini-sub enclosure shall be considered to be in accordance with ‘pollution degree 3’ of SANS 61439-1.

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3.2 Electrical requirements

3.2.1 Rated lightning impulse peak withstand level

a) The rated lightning impulse peak withstand level for all 12 kV equipment shall be in accordance with “List 3” given in SANS 876; and

b) The rated lightning impulse peak withstand level for all 24 kV equipment shall be in accordance with “List 2” given in SANS 876.

3.2.2 Transformer

a) The standard transformer power ratings for Type A and all variations of Type B mini-subs shall be:

1) 200 kVA (Type A only);

2) 315 kVA;

3) 500 kVA; and

4) 1000 kVA.

b) The MV nominal voltage shall be 3.3 kV, or 6.6 kV, or 11 kV or 22 kV, as specified in schedule A of the enquiry document;

c) The transformer unit shall be sealed and have a welded cover. The unit shall have no drain valve or oil level indicator; and

d) The transformer design shall be in accordance with 240-57648800 or 240-45395762.

3.2.3 Earthing

a) In the case of mini-subs of rating up to and including 500 kVA, a combined LV neutral-earth busbar (called the ‘LV neutral-earth’ bar) shall be provided. No separate LV earth bar shall be provided. See figure 1;

b) In the case of mini-subs of rating 1000 kVA, a separate LV earth bar and LV neutral busbar (called the ‘LV earth’ and ‘LV neutral’ bar respectively) shall be provided in the customer panel. See Figure 2;

c) The earthing configuration for the mini-sub shall make provision for a separate MV and LV earthing system. A 120mm^2 aluminium option or a suitable rated equivalent connection between the LV neutral-earth (for mini-subs of rating up to and including 500 kVA) or LV earth bar (for mini-subs of rating 1000 kVA) and the MV earth bar shall be provided and installed in accordance with SANS 1029;

d) A LV neutral surge arrester in accordance with D-DT-3088 shall be provided and positioned such that the 250 mm (max) insulated jumper is connected from the MV earth to the LV neutral-earth (for mini-subs of rating up to and including 500 kVA) or LV earth bar (for mini-subs of rating 1000 kVA). A suitable label shall be supplied to indicate the below note for consideration of each installation;

Note: According to the Eskom earthing philosophy, if the MV and LV earth electrodes are to be separated on site, the electrical bridge between the mini-sub earth bar and the LV neutral-earth bar would then be removed as required, and the neutral surge-arrester would be made effective.

e) For mini-substations of rating up to and including 500 kVA, two insulated conductors of cross-sectional area of at least 120mm^2 aluminium or a suitable rated equivalent each shall be fitted to provide an electrical bridge between the cable gland plate support structure and the LV neutral-earth bar figure 2;

f) For mini-substations of rating 1000 kVA, three insulated conductors of cross-sectional area of at least 120mm^2 aluminium or a suitable rated equivalent each shall be fitted to provide an electrical bridge between the cable gland plate support structure and the LV neutral bar;

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g) For mini-substations of rating 1000 kVA, three insulated r conductors of cross sectional area of at least 120mm^2 aluminium or a suitable rated equivalent each shall be fitted to provide an electrical bridge between the LV neutral bar and LV earth bar;

h) The neutral terminal of the transformer LV winding shall be connected to the LV neutral-earth (for minisubs of rating up to and including 500kVA) or LV neutral bar (for minisubs of rating 1000kVA). A suitably rated aluminium busbar or cable jumper solution shall be used; and

i) The MV earth bar connection protruding to the LV compartment shall be a suitably rated aluminium conductor.

3.3 LV assembly

a) The LV assembly shall consist of three separate LV panels i.e., Customer panel, Eskom panel, Metering and control panel;

b) Access to each LV panel shall be by way of an individual door that is lockable;

c) The Eskom panel shall be on the side of the miniature substation; and

d) Refer figure 1 and 2 for design layout.

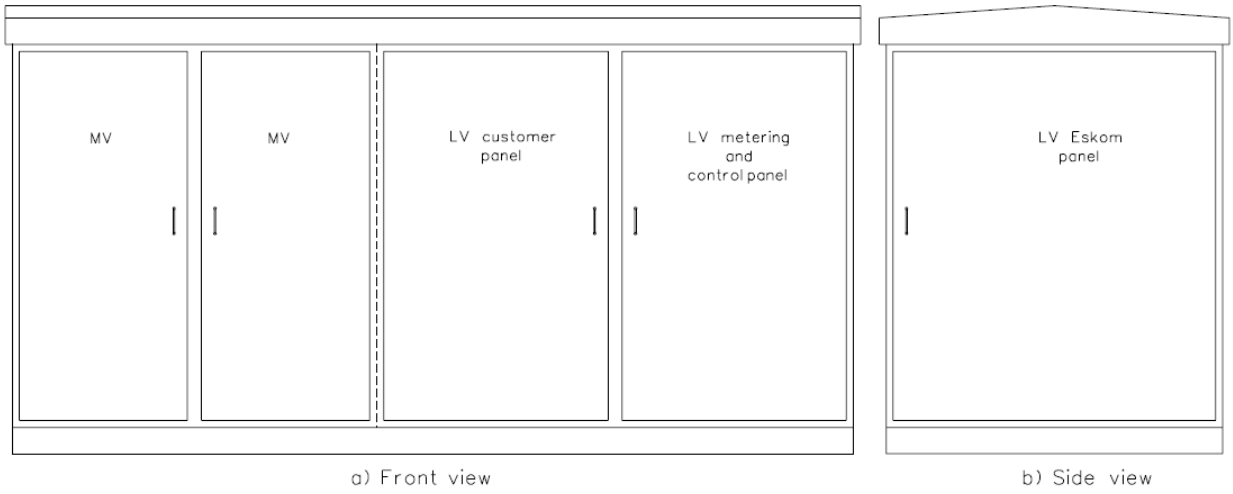


Figure 1. Miniature substation MV and LV compartment layout.

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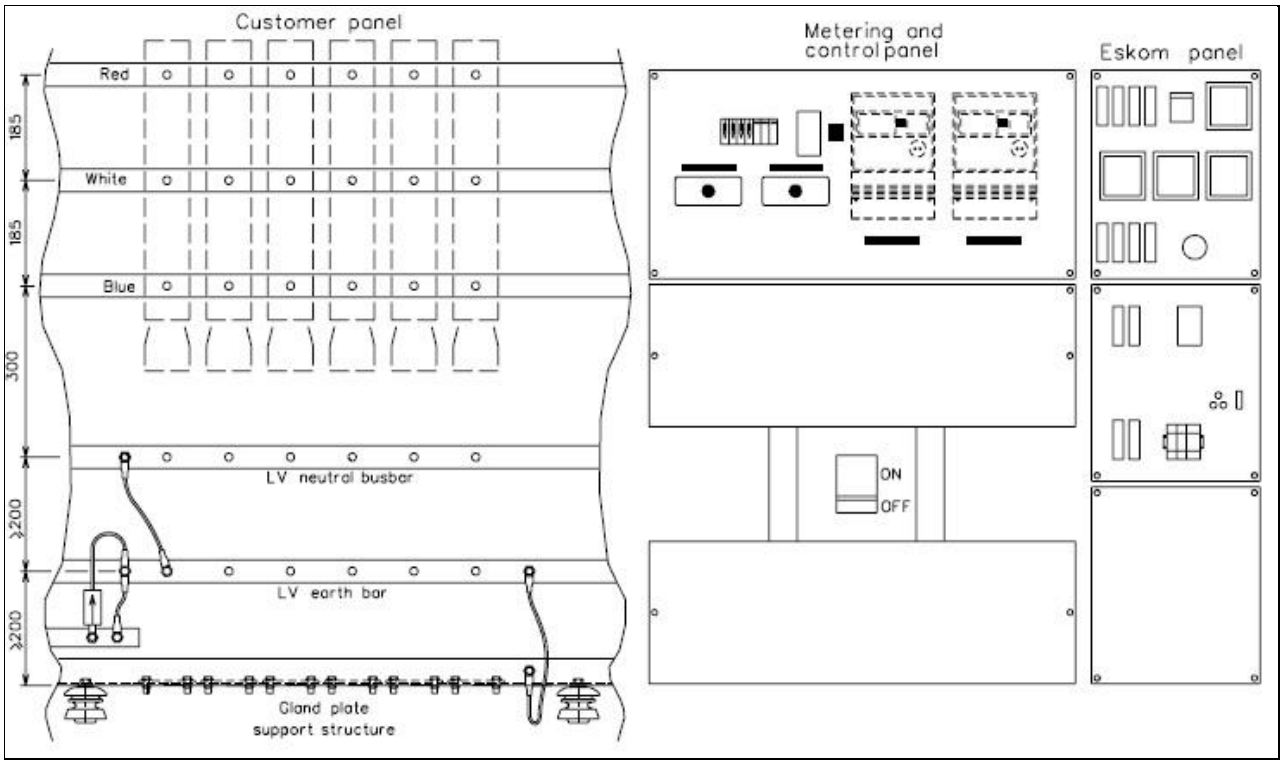


Figure 2. LV assembly design layout.

3.3.1 Eskom panel

The following equipment shall be fitted in the Eskom panel (see figure 2):

a) Single phase 16 A three pin socket-outlet and protection equipment. The socket outlet supply shall be taken from the LV busbars upstream from the metering current transformers;

b) LV ammeters ;

c) LV voltmeter and selector switch; and

d) Earth fault indicator (EFI) LV supply.

3.3.2 Metering and control panel

The metering and control panel is in figure 2 and D-DT 1013.

3.3.2.1 Metering requirements

a) A hinged meter plate shall be provided at the top of the LV assembly panel (see D-DT-1013 sheet 1) for all types of mini-subs up to and including 500 kVA, and at the top of the metering panel (see D-DT-1013 sheet1) for all 1000 kVA mini-subs. (check drawing -difference between 500/1000 kVA not shown) The meter plate shall be fitted with the following:

1) CT and VT test blocks;

2) Surge arresters;

3) HRC fuses; and

4) Terminals.

Note: Meter(s), data concentrators and modem will be supplied and fitted by Eskom.

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b) All wiring indicated on D-DT-1013 sheet 3 shall be provided and shall have sufficient slack to allow the meter plate to be hinged outward to at least 90° relative to the mini-sub LV compartment. The wiring that is to be terminated onto the meters shall be taken through the 32 mm diameter holes in the meter plate and shall have at least 300 mm of excess wire when measured from the 32 mm hole to the wire end with the meter plate hinged outward. The holes shall be fitted with a lining material to prevent damage to wires;

c) Current transformers (CTs) shall be fitted to the phase busbars and shall only be accessible once the meter plate has been hinged outward;

Table 1 LV CT ratios and ratings

Minisub type	CT ratio	Accuracy Class	VA rating
200kVA	300/5A	0.5	5
315kVA	500/5A	0.5	5
500kVA	800/5A	0.5	5
1000kVA	1600/5A	0.5	5

d) Adequate space shall be provided for the metering technicians to insert a primary current test probe over the LV busbars in order to confirm the CT ratios on site; and

e) All the current instrument transformers shall be tested for accuracy according to SANS 61869-2 by a SANAS approved laboratory before installation in the kiosk. The test results shall be shipped with the mini-sub in a suitable cover for protection against damage. A test label (sticker) shall be on each instrument transformer, certifying that the instrument transformer has been tested.

3.3.2.2 Metering voltage secondary circuit

a) The voltage circuit shall take its supply from the busbars;

b) The VT wires shall be connected onto fuse-holders situated on the short DIN rail at the back of the panel;

c) From the fuse-holders the wiring shall go to the bottom connections of a PK2 4-way test block. The removal of the male adapter of the test block shall ensure the open-circuiting of the voltage circuit. The terminals that protrude into the panel shall be suitably insulated from the steel edges;

d) Single-pole surge arresters shall be installed between the PK2 4-way test block and the terminals on the voltage circuit from all three phases – to ground and from neutral – to ground, to protect the meter or data concentrator from lightning; and

e) From the PK2 4-way test block the wiring shall go to the terminals and from there to the meter and / or data concentrator.

3.3.2.3 Metering current secondary circuit

a) The current supply wiring shall come from the CTs onto the bottom terminals of the PK2 4-way test block;

b) On removal of the male adapter, short-circuit parts shall ensure the short-circuiting of the current transformer terminals and earth. The terminals that protrude into the panel shall be suitably insulated from the steel edges; and

c) From the PK2 4-way test block the wiring shall go to the terminals and from there to the meter. Temporary short circuit wiring shall be installed on the terminals which must be removed after the meter has been installed.

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3.3.2.4 Metering circuit surge arrester specification

a) The surge arrester shall be the metal oxide, DIN rail mount type with LED indication suitable for Zone 1 protection. The arrester shall comply with SANS 61643-1 and bear the SABS mark;

b) The technical specification for the surge arresters shall be:

I_{max} (8/20 μs):	40 kA or 65 kA (4/20 μs)
Response time:	< 25μs
Maximum operating voltage:	275 V AC (phase-to-neutral) and 360 V DC
Frequency:	50 Hz
Internal fuse:	Yes
Open-circuit:	Open-circuit on expiry of the device
Indication :	Clear change-of-state (functional or non-functional) indication

3.3.2.5 Metering circuit HRC fuse specification

The LV HRC fuses shall comply with the requirements of SANS 60269-2, and the fuse holders shall be suitable for DIN rail mounting.

3.3.2.6 Meter, data concentrator and metering modem

The meter(s), data concentrator and modem shall be supplied by Eskom.

3.3.2.7 Metering circuit wiring

a) The mini-sub metering circuit shall be wired in accordance with the drawing D-DT-1013;

b) No individual wire numbering is required;

c) Not more than two conductors shall be connected to a terminal;

d) No bare wiring or bare part of lugs shall be exposed at termination points on the meter, the circuit-breakers, the relay base, fuse holders and the terminals; and

e) Only ratchet type crimping tools shall be used for the crimping of lugs.

3.3.2.8 Antenna hole

a) Two 22 mm diameter holes fitted with a rubber / plastic cover shall be provided on the side of the minisub for the fitment of an external antennas, for the metering modem and one for a Data Concentrator modem; and

b) The holes shall have protective back-plates fitted to the hole to prevent unauthorised access to the equipment inside.

3.3.2.9 LV control device

a) A main LV circuit-breaker shall be provided at the bottom of the panel in order to isolate the LV busbars from the transformer;

b) The connections onto the circuit-breaker/isolator on the line and load side shall be barricaded using removable metallic barriers;

c) The LV main circuit breaker protection relay shall be configured and set by the mini-sub manufacturer in accordance with the requirements given in Annex B;

d) The protection relay shall be installed, completely wired and ready for commissioning prior to delivery to Eskom; and

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e) No relay settings or commissioning tests will be required to be carried out by Eskom prior to energizing the mini-sub.

3.3.3 Customer panel

Customer panel is shown in figures 3, 4 and 5.

a) The LV busbars, earth bars and a gland plate arrangement shall be fitted in the LV customer panel as shown in figures 4 and 5;

b) The panel shall be designed and constructed for the use of either vertical fuse-bases or large frame MCCBs as specified in schedule A of the enquiry document;

c) In the case of mini-subs of rating 200 to 1000 kVA (both Type A and Type B), the LV customer panel shall be designed to accommodate a minimum of six outgoing LV cable feeder bays;

d) For mini-substations designed for the fitting of LV MCCBs, the LV feeder MCCB mounting plate and barricade plates shall be designed in accordance with the requirements given in figure 3. The corrosion requirements for the MCCB mounting plate shall be manufactured in accordance with clauses 3.4.2;

e) The MCCB mounting plate shall be made of perforated plate “Round 60 degrees staggered" with the following minimum specifications:

1) Aperture = 7 mm
2) Pitch of Aperture = 17 mm
3) Thickness of material = 3 mm
4) Minimum perforated area for Type B, L X W = 940 mm X 295 mm
5) Minimum perforated area for Type A, L X W = 510 mm X 295 mm
6) Note: Eskom no longer accepts MCCB mounting rails for the LV MCCB mounting equipment which can only accommodate MCCBs having the same frame size.

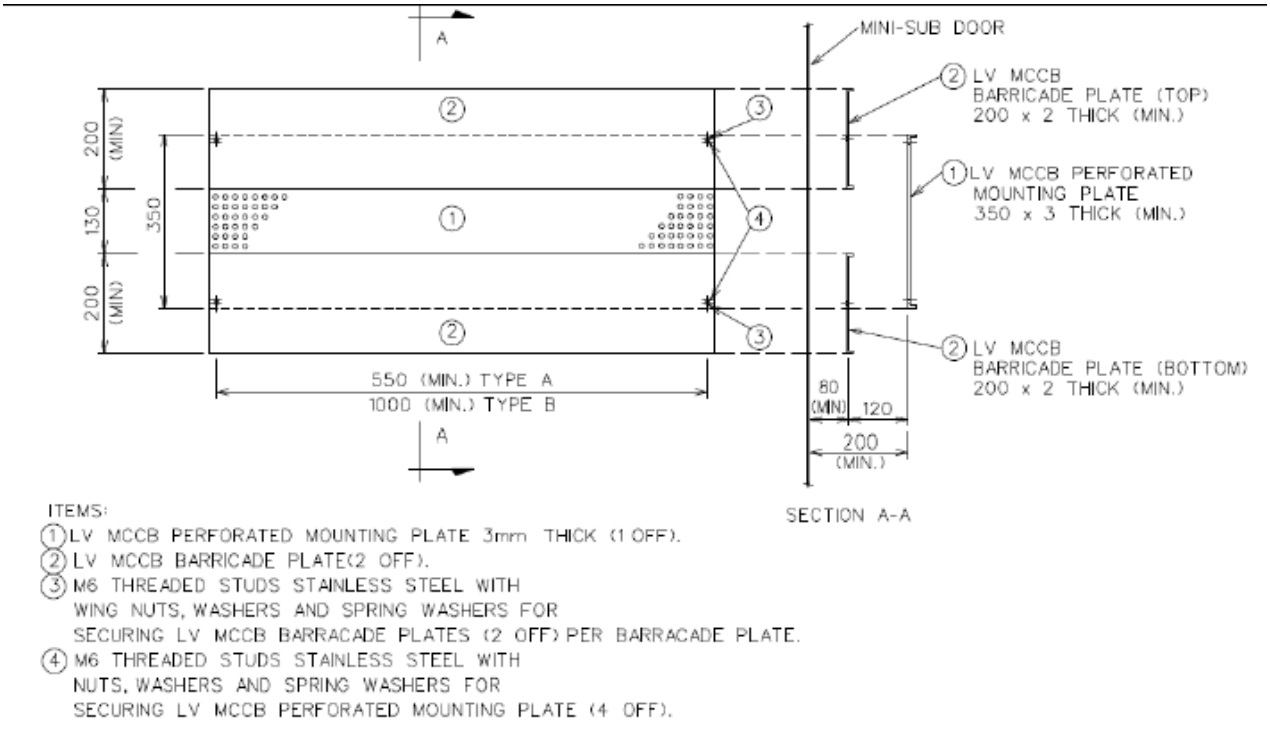


Figure 3. LV MCCB mounting details.

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f) If LV feeder MCCBs are called for at the time of tender, they shall be in accordance with the requirements of SANS 556-1 and SANS 60947-2 (see D-DT-3034). LV flexible Aluminium or CCAA shall be cable used to connect the MCCBs from the LV busbars. A suitable connector shall be used to avoid galvanic corrosion between the Al or CCAA cable and the MCCB terminals;

g) MCCBs shall be fitted with individual inter-phase flash barriers. Provision shall be made for the fitting of 6 x LV circuit breakers that are up to 150 mm wide and allowing for a clearance of 20 mm between circuit breakers. The spacing between the outer live terminals (metal) of adjacent MCCBs shall not be less than 25 mm. This is to ensure that the risk of a flashover occurring between adjacent MCCBs (i.e. between the blue and red phases) is minimised during a short circuit interruption event. The lug barrel and any exposed conductor of the single core flexible jumpers shall be adequately insulated;

h) If LV feeder vertical fuse holders are called for at the time of tender, they shall be in accordance with the requirements of SANS 60947-3 (see D-DT-3409) and suitable for type ‘gG-gL’ NH 2 (DIN) fuses for fuse system A in accordance with the requirements of SANS 60269-2 (see D-DT-3181);

i) The minimum diameter of the LV insulators used shall be 40 mm. The insulators shall have a cylindrical shape. The minimum diameter of the flat circular surface where the insulator makes contact with the frame and busbar shall be 25 mm. The insulators shall be at least 40 mm long (not including the projecting studs);

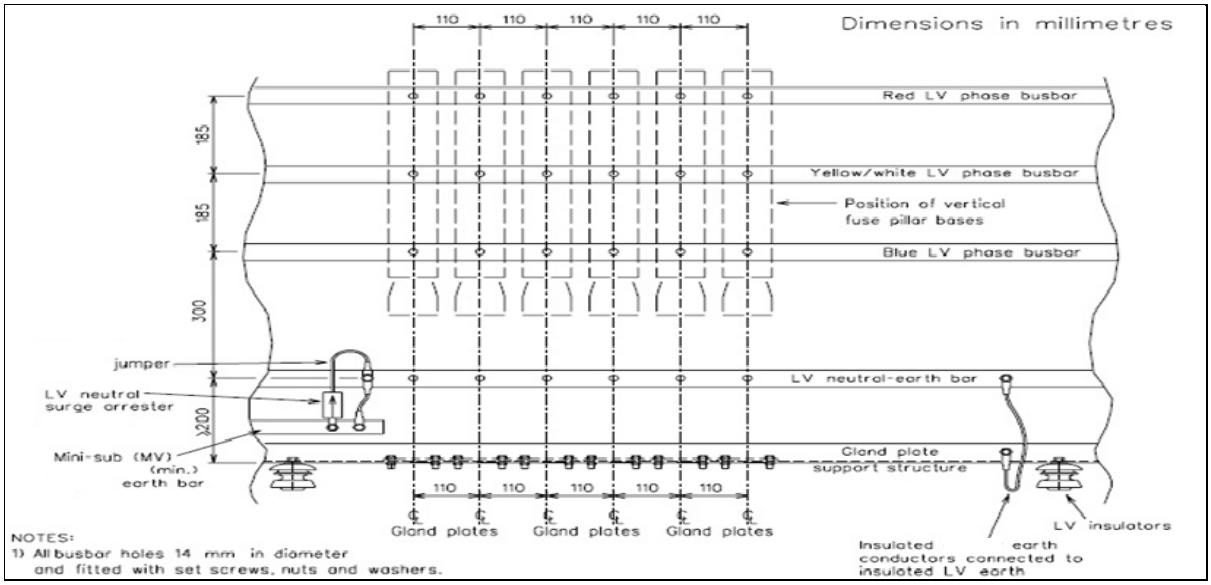


Figure 4. LV customer panel showing busbar and gland plate arrangement (mini-subs of rating up to and including 500 kVA).

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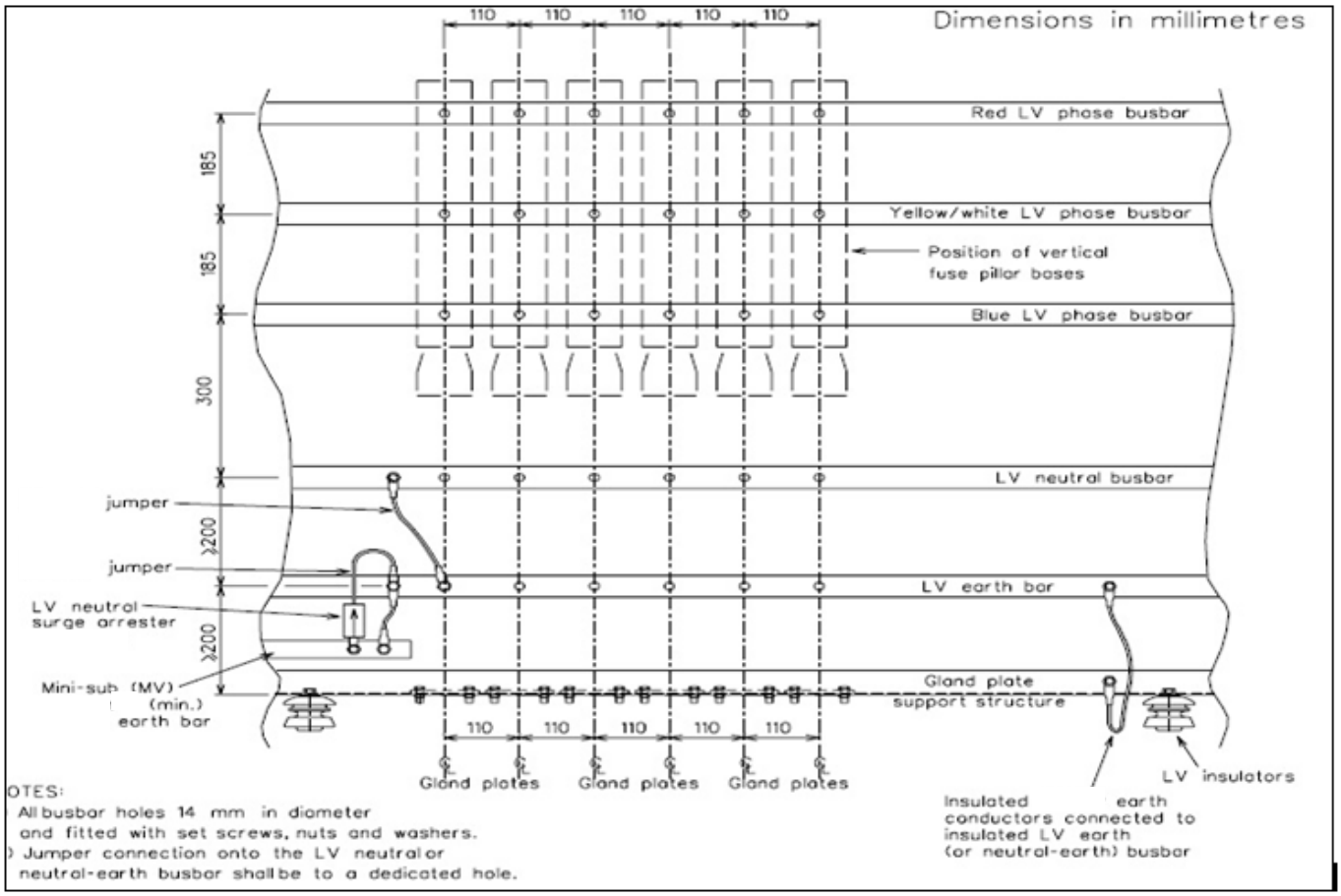


Figure 5. LV customer panel showing busbar and gland plate arrangement (mini-subs of rating 1000 kVA).

j) LV Busbars shall be manufactured from either Aluminium Alloy or CCAA in accordance with NRS 11;

k) All busbars shall be tinned or silverized in accordance with SANS 4521 using the coating classification Cu/Ag (0,95). The finishing method shall be stated in schedule B;

l) The rated normal current of the busbars of the LV assembly shall be equal to 1.2 times the rated secondary current at the lowest tap position of the transformer and are given in table 1;

m) The LV phase and neutral busbars shall be drilled to align with the LV cable outgoing feeders. The distance between adjacent feeder bay centre lines shall be 110 mm. The gland plate centre-line spacing shall therefore co-ordinate with the busbar hole spacing. The requirements for this shall be as per SANS1029;

Table 2 LV busbar current ratings

Transformer Rating (kVA)	LV busbar rating (A)
200	346
315	546
500	866
1000	1732

n) Stainless steel M12 set screws, nuts, washers and spring washers shall be provided for each of the 14 mm holes drilled on the LV phase, neutral and earth busbars; and

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o) The LV gland plate arrangement with outgoing feeder cable gland plates shall be provided and shall be suitable to carry the equivalent fault current that may be experienced during LV phase to earth faults downstream for at least 1 second.

3.3.4 Eskom panel

a) The following LV auxiliary equipment shall be provided LV ammeters shall be provided for all three phases. Additional electronic type ammeters will be required only in the case of IRTU fitted mini-subs;

b) One voltmeter shall be provided with a selector switch. Additional electronic type voltmeters will be required only in the case of IRTU fitted mini-subs;

c) A three-pin socket outlet and associated protection equipment in accordance with SANS 1029; and

d) All auxiliary wiring shall be numbered using an approved type of numbering ferrule at both ends of the wire. All wiring and ferruling shall be in accordance with D-DT-0868.

3.3.5 General electrical requirements

a) The mini-sub wiring shall be in accordance with D-DT-0868;

b) All LV auxiliary fuses shall comply with the requirements of fuse system G in accordance with SANS 60269-2 and shall be of size E1;

c) The current rating of the connections between the transformer LV bushings and the LV busbars (including those to and from the main LV interrupting device) shall be in accordance with table 2. Single core, Class 5, flexible aluminium alloy, fire retardant cable manufactured in accordance with SANS 1574-3 shall be used. (Single core, PVC-insulated flexible cables with stranded aluminium alloy conductors that comply with SANS 1574-3.) The number and size of the cables shall be selected to suit the continuous current and fault ratings of the transformer. The same configuration of cables as is used for each phase shall be used for the neutral. Appropriate derating factors shall be used where more than one cable is installed in parallel (bundled together);

d) The LV panel assemblies shall be so designed as to ensure thermal interaction does not unduly affect the performance of any of the components;

e) All terminal blocks shall be in accordance with 240-70413291 (DSP 34-253) and shall be Screw clamp spring loaded insertion type terminals; and

f) An earth-fault indicator (EFI) shall be provided with the mini-sub (i.e. Type A and Type B mini-subs). The EFI control unit shall be positioned on the right-hand side of the MV compartment, and the current sensor shall be fitted to the left-side ring cable. The EFI shall comply with the requirements of (DSP 34-1080). The remote indicating unit shall be mounted on the outside of the mini-sub enclosure in such a manner that it can be clearly viewed from the front of the mini-sub (street-front). The type (make / product) of EFI shall be stated in schedule B and the design details shall be submitted to Eskom for approval at the tender stage. Proposals for a cable fault indicator that provides earth fault and overcurrent fault indication for 3x single core, and 1x three core terminations shall be provided as part of a tender submission.

3.4 Construction requirements

3.4.1 Design

a) In the case of Type A mini-subs of rating up to and including 500 kVA, the general arrangement shall be in accordance with the Type A layout specified in SANS 1029;

b) In the case of Type A mini-subs of rating 1000 kVA, the general arrangement shall be in accordance with the Type B layout specified in SANS 1029;

c) In the case of Type B mini-subs, the general arrangement shall be in accordance with the Type B layout specified in SANS 1029;

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d) The base channel and sills of the doors shall be constructed with removable sections adjacent to the MV compartment door(s) to allow the MV cables to be moved into position. These sections shall be lap bolted with the nuts on the inside of the base channel and housing. The cable entry position shall correspond to that of the pre-cast plinth shown in drawing D-DT-0859;

e) All mini-sub doors (MV and LV) shall be recessed such that they are flush with the sides of the mini-sub enclosure;

f) The mini-sub enclosure, doors and lock protection facilities shall be manufactured using 3 mm thick 3CR12 stainless steel;

g) The doors shall be re-enforced using additional steel strength members diagonally welded from corner to corner on the inside surface of the door;

h) 3CR12 Stainless Steel or a corrosion resistant Heavy duty hinges shall be fitted for the doors. The design of the hinges shall be subject to approval by Eskom;

i) A three -point locking mechanism (i.e. at the top-centre, bottom-centre, left-centre or right-centre) using bars operated by a heavy-duty door handle shall be fitted;

j) Each compartment door shall have an additional, captive, 10 mm Allen cap screw;

k) All door handles shall be manufactured from 3CR12 stainless steel;

l) A padlock protection facility shall be provided for all mini-subs as shown in Figure 6;

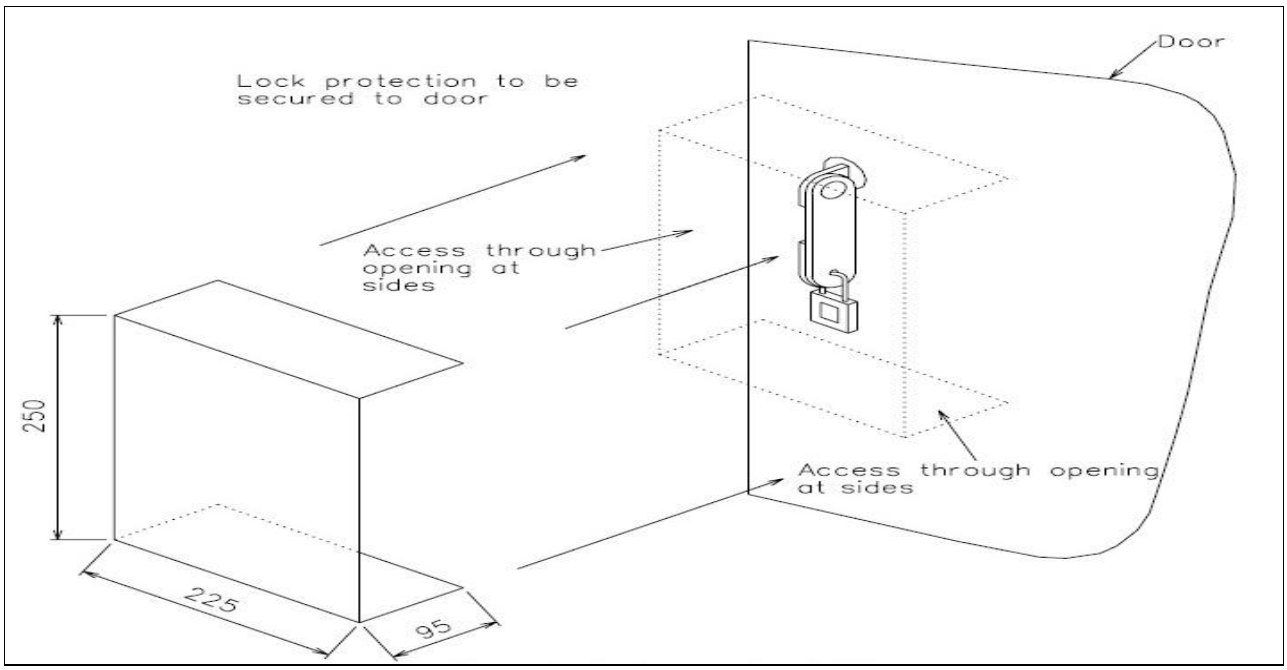


Figure 6. Padlock protection facility

m) The padlock protection facility shall provide access to the padlock from both sides;

n) A 15 mm Ø hole shall be provided in the front of the facility that corresponds with the position of the captive 10 mm Allen cap screw fitted in the door in accordance with SANS 1874;

o) If required during tenders, proposals for the additional fitting of remote controlled door locking devices may be required; and

p) If required during tenders, proposals for alternative mechanical door locking devices and padlock protection facilities may be required on Type B mini-subs only. The proposal for Eskom review shall include the operation and detailed design proposal of such mechanical door locking devices and padlock protection facilities.

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3.4.2 Materials and corrosion protection

a) The class of pollution characterising the site severity shall be “e” (i.e. “very heavy”) in accordance with SANS 60815-1:2009.

b) The mini-sub enclosure (padlock protection facility, roof, compartments and doors), LV ASSEMBLY steelwork and transformer tank shall be 3CR12, stainless steel.

c) The transformer-cooling radiator shall be mild steel.

d) The mini-sub base shall be hot-dipped galvanized mild steel and shall be finished with a black coating.

e) The gland plate support structure and gland plates shall be 3CR12 stainless steel.

f) The detailed corrosion protection specification shall correspond to a "corrosivity category" of C5 (i.e. "very heavy”) in accordance with 240-75655504. The detailed specification (DS) options in accordance with 240-75655504 are specified in schedule A. The detailed specification (DS) number offered in accordance with 240-75655504 shall be stated in schedule B.

g) A 5 mm thick cork packing (i.e. cork gasket) shall be installed between the mini-sub end compartments and the transformer tank section, between the base and the end compartments, and between the base and the transformer tank section.

h) The final colour of the mini-sub enclosure (roof, compartments and doors) and transformer shall be Avocado C12 in accordance with SANS 1091. Proposals for an alternative suitable colour as close as possible to Avocado may be submitted for Eskom review and consideration.

3.5 Specific requirements for Type A mini-subs

A Type A mini-sub shall comprise of the following:

a) A medium-voltage compartment that consists of extensible screened separable connectors at 11 kV and 22 kV (see figure 4 and figure 5) to be used as an off-load, dead-break isolating arrangement in the MV compartment;

b) A transformer compartment housing the transformer; and

c) A low-voltage compartment housing the LV assembly for LV equipment.

3.5.1 Electrical requirements

3.5.1.1 Transformer MV bushings

a) The transformer bushing-centre spacing shall be ≥ 180 mm and the distance between the outer bushing centres and the mini-sub metal enclosure shall be ≥ 80 mm. The actual distances provided shall be indicated in schedule B of the enquiry document.

Note: The transformer bushings centres are based on the fact that screened separable connectors (SSCs) are used for the termination of the MV interconnections onto the transformer bushings.

3.5.1.2 LV main circuit breaker and transformer overload protection facility

a) A main LV circuit breaker shall be provided in the LV compartment between the transformer and the LV busbars. The type (i.e. make / product) of circuit breaker offered shall be stated in schedule B. The circuit breaker shall be fitted with a shunt-trip facility that is wired to a temperature-sensing element fitted to the transformer. The LV circuit breaker shall be set as per the requirements of Annexure A;

b) The transformer unit shall be fitted with a top-oil thermoelectric temperature-sensing element. This shall trip the LV circuit breaker through a shunt-trip facility when the transformer top-oil temperature exceeds 105 ºC. The relay used to provide the shunt-trip facility shall be housed in an enclosure and sealed with a 304 stainless steel meter sealing wire and a 12 mm tinned copper ferrule(refer D-DT-3132);

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c) The transformer unit shall be fitted with a top oil temperature gauge which indicates the top oil temperature in degrees Celsius. The transformer top-oil thermoelectric protection element switch (contacts for shunt tripping facility) shall be incorporated with the temperature gauge. A dial type analogue gauge is preferred.. Detailed drawings and test reports of the temperature gauge pocket design that was tested and proven to function correctly need to be submitted as part any tender or enquiry;

d) The standard ratings for the main LV circuit breaker shall be as indicated in table 3.

Table 3 Standard LV circuit breaker ratings

Transformer Rating (kVA)	LV busbar	MCCB rating (A)
200	346	300
315	546	450
500	866	800
1000	1732	1600

3.5.2 Construction requirements

3.5.2.1 11 kV and 22 kV Type A mini-subs

a) The general arrangement of 11 kV and 22 kV mini-subs shall be in accordance with the Type A layout specified in SANS 1029;

b) Provision shall be made for the support (clamping) of two incoming cables (up to 185mm2 each) in the MV compartment. Two cable clamps (see D-DT-8019) shall be provided with the mini-sub in accordance with SANS 876.The cable support clamps shall be range taking for cables with outer diameters of 50 – 75 mm;

c) Where required for single core applications (to be specified in Schedule A), provision shall be made for 6x single core cables up to 300 mm^2.i.e one clamp for each core. The cable support clamps shall be range taking for cables with outer diameters of 25 mm to 50 mm;

d) The clamps shall be securely fitted, ensuring that the distance from the cable support point (clamp) to the transformer bushing centres shall be at least 800 mm. The transformer bushings shall be horizontally positioned in a straight line;

e) The MV compartment shall have a front and end door (no rear door is required);

f) The MV compartment shall have a minimum internal width of 700 mm; and

g) The height of the MV compartment door opening shall be at least 150 mm above the horizontal bushing centre-line.

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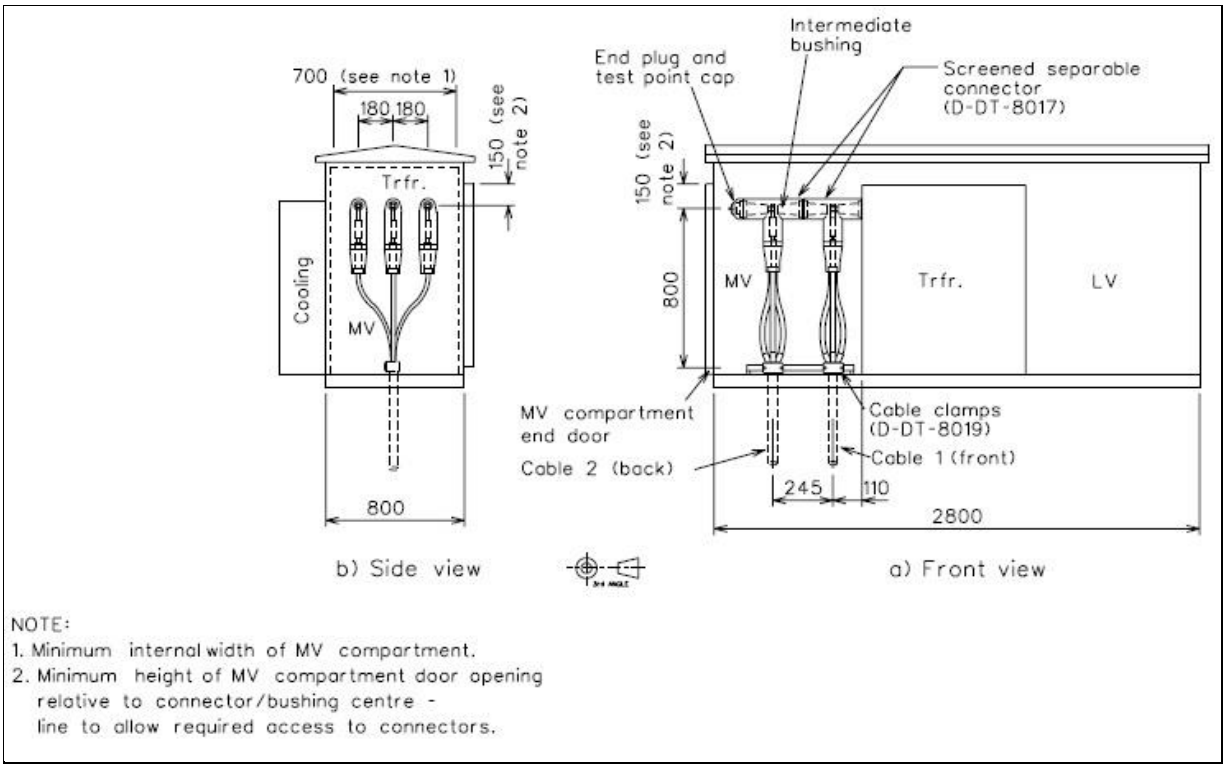


Figure 7. 11 kV and 22 kV Type A mini-sub of rating up to and including 500 kVA.

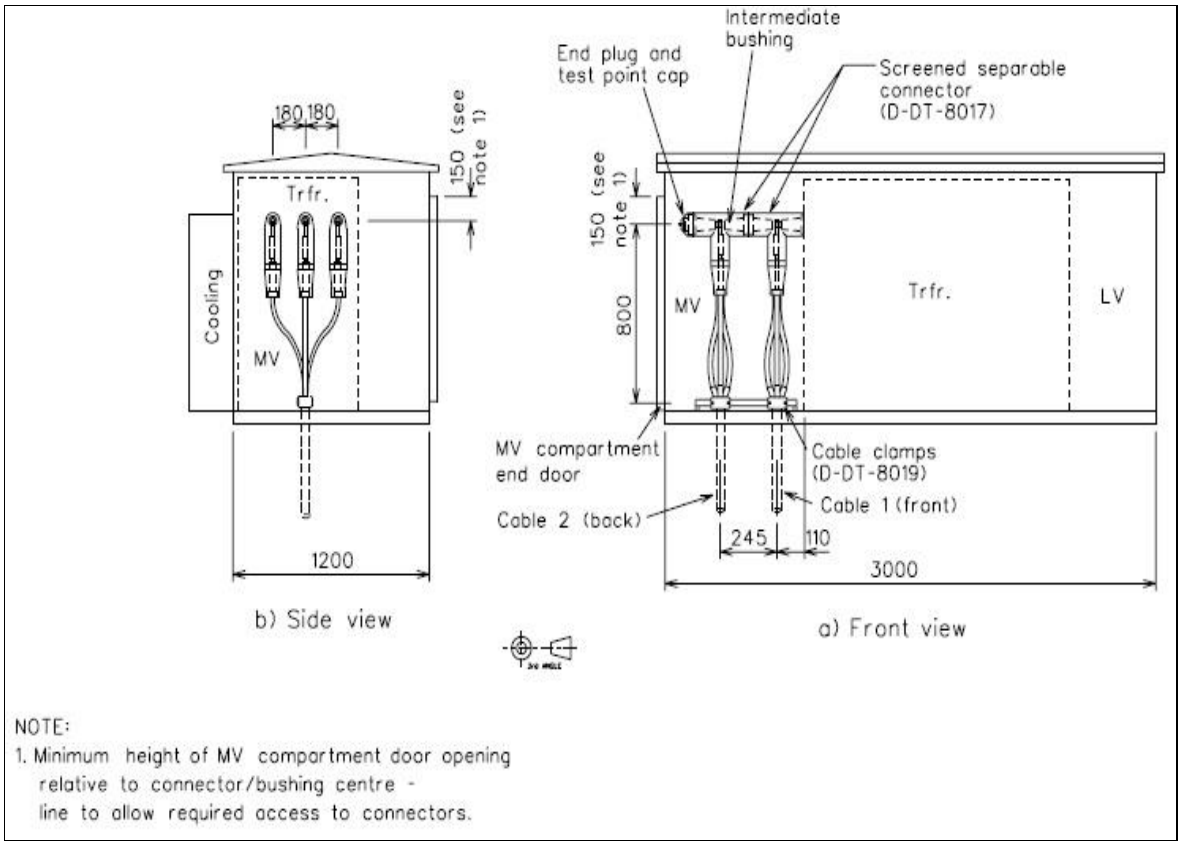


Figure 8. 11 kV and 22 kV Type A mini-sub of rating 1000 kVA.

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3.6 Specific requirements for Type B mini-subs

A Type B mini-sub shall comprise of the following:

a) A medium-voltage compartment that is fitted with a non-extensible '2R-1B' ring main unit;

Note: A '2R-1B' ring main unit consists of 2 ring switch-disconnectors ('R' functions) and a circuit breaker tee-off ('B' function) which is used to supply the mini-sub transformer. This is equivalent to a '2SD-1CB' ring main unit configuration in accordance with SANS 1874.

b) A transformer compartment housing the transformer;

c) A low-voltage compartment housing the LV assembly for LV equipment; and

d) Where 3.3 kV and 6.6 kV Type B mini subs are required, the mini sub shall be constructed in accordance with the 11 kV mini sub requirements. The transformer rating and protection settings shall however be adjusted accordingly.

3.6.1 MV ring main unit (RMU)

a) The ring main unit shall comply with the requirements of 240-56030406 "Specification for Ring Main Units for Systems with Nominal Voltages from 3.3kV to 33kV";

b) Provision shall be made for 3x single core cables up to 300 mm^2 or 1x three core cable up to 185mm^2 to terminate in the 2R cable termination compartments. Three cable support clamps with range taking of 25mm-50mm and one clamp with range taking of 50mm- 75mm shall be fitted and supplied in the RMU;

c) Circuit breaker protection relay

1) The protection tripping of the circuit breaker shall be through a self-powered protection relay with correctly rated matching CTs. and shall include:

i. Two configurable digital inputs (for external Trip input); and

ii. Fault event recorder capable of storing history of the last 5 events.

2) The protection relay shall be in accordance with 240-64685228 and application of Protection settings shall not be possible via external switches (DIP / Dials). The relay shall only be settable via an external device i.e. computer with configuration software. Configuration software shall be compatible with latest Windows operating system i.e. Windows 11 (64 Bit);

3) The protection CT type and class shall be stated in schedule B;

4) The protection relay shall provide an over-current function with an HRC fuse characteristic or an extremely inverse (IDMTL) protection element in accordance with 240-64685228 and include Inrush current detection blocking function;

5) The setting ranges (pick-up settings, time multipliers, delay times) and resolutions of the overcurrent, earth fault (PTOC) and high-set instantaneous (PIOC) protection elements shall be in accordance with 240-64685228;

6) The setting ranges, resolutions and protection element curves provided shall be stated in schedule B;

7) The protection relay and CT combination shall operate according to specification up to the rated short-circuit breaking current of the circuit breaker;

8) The relay and terminal blocks of the protection relay shall be easily accessible from the front of the ring main unit (e.g. for testing purposes);

9) The relay shall be positioned and installed in such a way that it is possible to exchange it with minimal effort and tools;

10) The protection relay, and current transformers shall be installed and wired complete for service;

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11) The wiring from the protection relay to the current transformers shall be in accordance with 240-56063705 unless otherwise approved by Eskom; and

12) Once the relay has been set, it shall be sealed with a stainless steel meter sealing wire and a 12 mm tinned copper ferrule(see D-DT3132) to indicate evidence of tampering.

3.6.2 MV Interconnections between ring main unit and transformer

a) The screened cables shall be terminated onto the transformer bushings and RMU bushings using screened separable connectors (SSCs). The screened cable shall be compliant to SANS 1029; the type (i.e. make / product) offered shall be stated in schedule B. The applicable test reports and drawings shall be submitted for the Eskom evaluation thereof during tenders;

b) The screened separable connector (see D-DT-8017) to be used shall be in accordance with the requirements of SANS 1332 and the type (i.e. make / product) offered shall be stated in schedule B. Full type test reports, installation instructions (SSCs and terminations only) and routine test certificates shall be submitted for Eskom evaluation of the MV interconnection; and

c) The design details of the interconnection arrangement shall be submitted to Eskom for approval at the tender stage.

3.6.3 Transformer MV bushings

a) The transformer bushing-centre spacing shall be ≥ 90 mm and the distance between the outer bushing centres and the mini-sub metal enclosure shall be ≥ 50 mm. The actual distances provided shall be indicated in schedule B of the enquiry document.

Note: The transformer bushings centres are based on the fact that screened separable connectors (SSCs) are used for the termination of the MV interconnections onto the transformer bushings.

3.6.4 Transformer overload protection

a) The transformer unit shall be fitted with a fully integrated top-oil thermoelectric temperature-sensing element, capable of displaying the Top Oil Temperature °C and include two settable output contacts, one thereof for Tripping the tee-off Circuit Breaker . This shall be capable of tripping the ring main unit tee-off circuit-breaker through a 240 V ac shunt-trip facility when the transformer top-oil temperature exceeds 105 ºC. The relay used to provide the shunt-trip facility shall be housed in an enclosure and sealed with a stainless steel meter sealing wire) and a 12 mm tinned copper ferrule(see D-DT-3132;and

b) This top oil temperature gauge shall indicate the top oil temperature in degrees Celsius, and also include a separate resettable indicator for Max Temperature °C. A dial type analogue gauge is preferred. Digital gauges may be required for IRTU fitted mini-subs and will be subject to approval by Eskom.

3.6.5 LV main breaker

a) For mini-subs of ratings up to 1000 kVA, a main LV circuit breaker shall be provided in the LV end compartment between the transformer and the LV busbars. The type (i.e. make / product) of circuit breaker offered shall be stated in schedule B;

b) Example of protection LV MCCB settings for various sizes of the Type B mini subs are indicated in Annex A;

c) The standard ratings for the main LV circuit breaker shall be as indicated in table 4.

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Table 4 Standard LV circuit breaker ratings

Transformer rating kVA	LV main circuit breaker rating A	Switch Type
315	450	Circuit-breaker
500	800	Circuit-breaker
1000	1600	Circuit-breaker

3.6.6 Provision for holding down the outdoor mini-sub

a) The mini-sub base shall have four 24 mm Ø round mounting holes dimensioned and positioned to align to the miniature substation plinth requirements in accordance with front entry only plinths from Eskom D-DT-0859.

3.6.7 Ring main unit protection relay settings and testing

a) The protection relays shall be configured, set and tested by the mini-sub manufacturer in accordance with the requirements given in Annex B. The protection relays and current transformers shall be installed, completely wired, tested and ready for commissioning prior to delivery to Eskom;

b) Example of protection relay settings for various sizes of the Type B mini subs are indicated in Annex A; and

c) No relay settings or commissioning tests will be required to be carried out by Eskom prior to energizing the mini-sub.

3.7 Additional general requirements for 1000 kVA mini-subs

3.7.1 Design and construction

a) The 1 MVA Type B mini-sub shall be suitable for the standard Type B mini-sub plinth, and the 1 MVA Type A mini-sub shall be suitable for the special 1 MVA Type A mini-sub plinth in accordance with D-DT-0859.

4. Transformer losses and capitalization

a) The following loss capitalization formula will be used in the evaluation of any tender, to establish the net present value of the total cost of the transformer;

The transformer cost shall be evaluated as follows:

b) Evaluated Cost = P + [A * E] + [B * L];

c) Where: P = Transformer tender price;

d) A = Evaluated Cost of No-load loss per kW;

e) B = Evaluated Coast of Load loss per kW;

f) E = No-load loss in kW;

g) L = Load loss in kW;

h) The economic life of a transformer is assumed to be 25 years;

i) The values of parameters A and B are given in the technical schedules. These parameters will be revised with each enquiry;

j) Regardless of the use of the capitalization formula, the losses shall not be greater than those specified in SANS 780;

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k) Load and no-load losses, the percentage impedance and the X/R ratio of the transformer shall be stated in schedule B of the enquiry document. The load losses and the percentage impedance shall be stated at 75 ºC, in accordance with SANS 780;

l) All losses will be capitalised using the formula below when adjudicating the tenders; and

m) The manufacture shall guarantee the following losses for each transformer:

1) No-Load loss in kilowatts at rated voltage and rated frequency;

2) Total losses in kilowatts at rated output, rated voltage and rated frequency; and

3) Transformer losses determined under tests shall be corrected to 75°C. No-Load loss shall not be corrected.

5. Tests

5.1 General requirements

a) The supplier shall cover the cost of all type and routine testing required and may be requested to provide Eskom with the details of when and where these tests will be conducted. Eskom reserves the right to witness any or all of these tests. Should Eskom indicate their intention to witness specific testing, it shall be the responsibility of the tenderer to make arrangements with the test facility to enable Eskom to witness such tests;

b) Type tests are intended to prove that the design and construction of a given device fulfil the specified safety standards and functional performance requirements and are therefore only performed once. It shall be the responsibility of the equipment manufacturer to evaluate the impact of any changes to the design, components or material on the outcome of type test performed. Any change that could possibly impact the outcome of the type test (performed at component level or unit level) shall require retesting. The results of the type tests are recorded as evidence of compliance with design requirements;

c) Suppliers shall submit English copies all the required type test reports. If the units offered have been tested for compliance with an alternative internationally accepted standard, Eskom may accept those test reports on condition that the minimum Eskom requirements have been met. English copies of such type test reports and all relevant alternative test standards shall be submitted with the tender, for Eskom’s consideration;

d) The supplier shall ensure that type tests are valid;

e) If there is reasonable doubt as to the validity of test certificates submitted, for example, by virtue of modifications made to the mini-sub, Eskom may direct that further tests are carried out at an accredited test facility in the presence of a suitable Eskom technical representative, on a sample unit of the mini-sub in question. These tests shall be at the expense of the supplier; and

f) Routine tests are intended to prove conformance of units to specific requirements and are performed on every unit. These tests shall be non-destructive.

5.2 Qualifying tests

a) The tests specified in SANS 1029 and the Eskom specification 240-56062752 shall be performed to establish the design characteristics of the mini-subs and assure compliance with the requirements specified in this specification;

b) The tests shall be conducted on new units in the same state as they are normally supplied. Tests specified for the components to be supplied (for example, the ring main unit, transformer, etc.) shall be carried out in accordance with the relevant component specifications as referenced;

c) All type testing shall be done at ILAC MRA accredited test facilities, unless otherwise permitted for specific transformers tests only;

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d) Where transformer in house testing are considered, the in house testing facilities must be evaluated as part of factory evaluations during tenders by a suitable Eskom technical representative, to proof the manufacturers testing capability and compliance. If the manufacturer testing facilities are not compliant to Eskom requirements, the manufacturer will by default be required to perform the tests at an accredited local or international testing facility; and

e) The additional testing requirements as specified in this 240-56062752 standard may be allowed to be performed as part of the contract award strategy. This will only be considered if suitable designs and minimum information required are submitted and found compliant in accordance with the relevant technical evaluation criteria document issued with each tender. All costs related to these tests as part of contract award shall be for the supplier account and may be witnessed by a suitable Eskom technical representative at Eskom's discretion. English copies of the type tests certificates shall be issued for these additional tests performed.

5.3 Additional testing requirements

5.3.1 Transformer temperature rise test

a) In order to account higher average ambient temperatures in South Africa as well as for solar radiation on the mini-sub enclosure, the mini-sub transformer temperature rise limits shall be as follows:

1)Top oil- temperature rise 55° K

2)Average winding temperature rise 60° K

3)Hot spot temperature rise 73° K

b) In addition, the transformer rated current (and thus load-losses) shall be increased by 5 % when carrying out the temperature rise testb) The additional 5 % current is specified so that the full mini-sub transformer rating plate power can be delivered when calculated using the full load secondary voltage of 420 V.

5.3.2 Internal arc classification test for Type B mini-subs

a) As per the requirements of SANS 1029 all Type B mini-subs shall be tested in accordance with SANS/IEC 62271-202. The following requirements for these tests shall apply:

1) The tests shall be performed on the mini-sub enclosure design offered during tender (i.e. same material, dimensions, manufacturing method, manufacturer, manufacturing location, etc.);

2) The tests shall be performed on each RMU manufacturer type offered, and each RMU shall be tested inside the exact mini-sub enclosure design offered;

3) All the related SANS/IEC 62271-200 and SANS/IEC 62271-202 compliant type test reports for the selection of tests on HV switchgear for the proof of class IAC-A and IAC-B as per SANS/IEC 62271-202, shall be submitted for the Eskom safety review and technical evaluation. This shall include the applicable type test reports for each RMU manufacturer option offered where applicable, and each mini-sub enclosure manufacturer design and RMU manufacturer option offered; and

4) If IAC-A and IAC-B classification tests in accordance with IEC 62271-200 were compliant on both the switching compartment and the cable compartment; then it will not be required to repeat the IEC 62271-202 test in the switching compartment. Thus, suppliers will be required to perform the IAC AB classification tests in accordance with IEC 62271-202 in the cable compartment only.

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5.3.3 Screened separable connectors and MV cables for MV interconnection

a) The make and type of screened separable connectors and MV cables offered in accordance with 240-56030619 and SANS 1029 shall be stated, and the relevant type test reports, drawings and installation instructions in accordance with SANS 1332 and SANS 1339 shall be submitted as part of tender evaluations; and

b) All MV cable terminations shall be performed by suitably trained person.

6. Marking, labelling, packaging and transport

6.1 Marking and labelling

6.1.1 Mini-sub rating plate information

a) In addition to the mini-sub rating plate, the following statement shall be included “MANUFACTURED TO ESKOM Standard240-56062752 ”.

6.1.2 Signs

a) A sign depicting “Treatment and Full First Aid Instructions” (see D-DT-6073 “SIGN D, E”) shall be permanently attached to the inside of the MV and LV compartment doors. For applications with double doors, the sign shall be attached to the inside of the door that opens first; and

b) External aluminium or ‘Chromadek’ electrical symbolic MV warning signs (warning-flash, see D-DT-3202, sheet 5 of 6) and LV warning signs (warning-flash, see D-DT-3202 sheet 4 of 6) shall be permanently attached to all the MV and LV doors respectively. If pop-rivets are used to attach the signs to the mini-sub doors, only aircraft or blind pop-rivets will be acceptable. Normal pop-rivets are not acceptable.

6.1.3 Labels

a) The primary voltage, secondary voltage and ‘kVA’ rating shall be stencilled on the mini-sub housing;

b) The corrosion protection category (i.e. “COASTAL”), total mass (in kg) and Eskom SAP (stock) number shall be neatly and uniformly stencilled on the side (fixed panel) of the mini-sub, e.g. “COASTAL 3500 kg SAP XXXXXXX”;

c) Main circuit designation labels shall be blank (orange-black-orange) sandwich-board or equivalent:

1) For Type A mini-subs, the labels shall be located in fixed positions adjacent to the cable support clamps provided. A label need not be provided for the tee-off to the transformer; and

2) For Type B mini-subs, the labels shall be located on fixed positions at the front of the ring main unit adjacent to each cable box. A label shall be included for the tee-off to the transformer.

d) For Type B mini-subs, the ring main unit push buttons provided for switching devices that incorporate stored energy operation shall be labelled accordingly (i.e. “TRIP” for the trip/open button and “CLOSE” for the close button if applicable). The labels shall be text with black letters at least 10 mm high on an orange background;

e) For Type B mini-subs, a short operating procedure shall be provided for the ring main unit tee-off indicating the steps required to:

1) Isolate and earth the tee-off;

2) Close the tee-off’;

3) The operating procedure shall be in text with black letters at least 5 mm high, on an orange background;

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4) A drawing depicting the wording of the operating procedure label shall be provided and referenced in schedule B; and

5) If specified in Schedule A, an Eskom approved RFID tag shall be provided in accordance with 240-171000428. The positioning of the tag shall be agreed to between Eskom and the manufacturer.

7. Documentation

7.1 Technical schedules and test schedules

Technical schedules shall be separate spreadsheets published together with this standard. These technical schedules consists of schedules A&B, test schedules, component schedules, transformer design and general schedules, tools, spares and drawings schedules and a deviation schedules. The schedules shall be completed, signed and submitted to Eskom for tender purposes.

7.2 Drawings

a) In addition to the drawing requirements specified in SANS 1029, the following information shall be included on the drawings when submitted to Eskom for approval at the time of tendering:

1) The general assembly drawing shall make reference, where applicable to the following Eskom Distribution Drawings: D-DT-8019, D-DT-3088, D-DT-3202, and D-DT-6073;

2) Any revision to drawings and diagrams shall clearly indicate the revision number and date; and

3) All drawings pertaining to Control Plant secondary circuits i.e. Protection, Metering and IRTU complete system (if applied).

b) In the case of Type B mini-subs, an additional drawing depicting the wording of the operating procedure label for the ring main unit tee-off shall be supplied by the supplier for approval.

7.3 Test reports and certificates

All required type test reports and certificates if available shall be submitted to Eskom, in English, by the manufacturer at the time of tendering and/ or pre-qualification.

8. Spares

A spares proposal for all type mini-subs shall be listed and shall be submitted during tender submissions for Eskom review. The spares proposal shall be indicated in the Technical Schedules A&B. If no spares are proposed it shall be indicated as such.

9. Accessories

a) For Type B mini-subs, if a hand-held push-button remote control unit with a portable power supply is to be supplied with the ring main unit, it shall be specified in schedule A. If required, these accessories shall be supplied in accordance with the requirements specified in 240–56030406 , 240-170000721 as well as D-DT8061 .Details of the hand-held remote control unit (type of connector, length of umbilical cord, etc.) shall be specified in schedule A. The female coupler of the plug-in connector shall be connected to the end of the umbilical cord. Details of the portable power supply offered shall be given in schedule B;

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b) A suitable quantity (length) of UV-stable sealant strip (e.g. Neoprene or equivalent strip) with an adhesive layer shall be supplied with every mini-sub. This shall be evaluated and reviewed by Eskom during tenders. The sealant is intended for application between the mini-sub steel base and the concrete plinth and shall be in accordance with D-DT-8029. The total quantity (length) may be supplied in several smaller strips with a minimum length for each individual steel base side. The material shall be suitably packaged and stored inside the mini-sub MV compartment with suitable installation instruction; and

c) Each Type B mini-sub shall be supplied with four M16 × 40 mm holding-down set screws for mounting onto the mini-sub plinth. The bolts shall be suitably packaged and stored inside the mini-sub MV compartment.

10. Training

a) A training proposal for the installation, operation and maintenance of all type mini-subs and their associated main components (i.e. Mini-sub, RMU, and LV compartment where applicable) offered, shall be submitted during tender submissions for Eskom review. The submission shall include the training levels required, a list of the documentation that will be used for training material, time required and a list of practical sessions;

b) The preferred methodology for Eskom would be for the OEM to train the Eskom trainers who will in turn train the rest of the Eskom staff requiring training. The number of people to be trained will be negotiated at contract stage; and

c) See document 240-56065202 (Switchgear Training Requirements from Original Equipment Manufacturers Standard) for the RMU operation and maintenance training requirements.

11. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Lerato Lekhema	Senior Manager: DX Technology and Engineering
Jacques Paulse	MV/LV Cable Systems CG: Convener

12. Revisions

Date	Rev.	Compiler	Remarks
Aug 2026	4	S. Mtshaulana/N. Booyens	**2.2 Normative/Informative references** **Updated the normative references with** a) 240-56030406: Specification for Ring Main Units for Systems with Nominal Voltages from 3.3 kV to 33 kV. b) DSP_34-1080: Specification for fault path indicators for cable and overhead line networks up to 132kV; c) 240-75661431 Specification for Mineral Insulating Oils (uninhibited and Inhibited)-Purchase, Management, Maintenance and Testing d) 240-75661431 Specification for mineral insulating oils (uninhibited and Inhibited)-Purchase, management, maintenance and testing;

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e) 240-170000721: Technical Clarifications Associated with 240-56030406 RMU Specification Revision 2.

Removed normative references:

a) 240-97690165 (DSP 34-2123): Specification for telecontrol requirements for ring main units

b) DDT 8016 Unscreened separable connectors

c) DDT 8026 – LV flexible copper cables

Corrected 240 no for Switchgear training requirements refer to

a) 240-124520996: Switchgear Training Requirements from Original Equipment Manufacturers Standard

D-DT-3196, Ferrule, tinned Cu sealing 12mm LG is now on **DDT 3132.**

2.3 Definitions

Removed reference to

IRTU fitted Type B mini-sub
IRTU
High Risk type B mini-sub

2.4 Abbreviations

Added the following abbreviations

EFI Earth Fault Indicator

CT Current Transformer

IED Intelligent Electronic Device

CB Circuit Breaker

VDS Voltage Detecting System

SSC Screened Separable Connector

OEM Original Equipment manufacturer

RFID Radio Frequency Identification

CBCT Core Balance Current Transformer

Removed from abbreviations

PECU Photo Electric Control unit

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			3 Miniature substations requirements 3.2.1 Removed specific references to tables referenced in SANS standards 3.2.3 Earthing Removed 70mm^2 copper earth conductor connections and replaced it with 120mm^2 Al or CCAA options . Between the trf neutral and LV earth /neutral busbars, allowed for a suitably rated aluminium busbar or cable jumper solution shall be used Added: The MV earth bar connection protruding to the LV compartment shall be a suitably rated aluminium conductor. **3.3 LV assembly** For all ratings of msubs the LV compartment has been standardised to the 1MVA msub configuration i.e. a) The LV assembly shall consist of three separate LV panels i.e., Customer panel, Eskom panel, Metering and control panel. With below requirements Access to each LV panel shall be by way of an individual door that is lockable. The Eskom panel shall be on the side of the miniature substation **3.3.2 Metering and control panel** Standardised on LV circuit breaker for Type A and Type B and all msub ratings. This provides LV operation to the LVO. **Metering circuit wiring** Brand names for ratchet type crimping tools removed **Antenna hole** Added extra hole for DC external modem antenna if required **3.3.Customer panel** No of outgoing LV feeders std to 6 for all ratings for Type A and Type B – previously 500kVA and less had 5 outgoing and LV busbars changed from copper to tinned Aluminum Alloy or CCAA **3.3.5 General electrical requirement** EFI IRTU output requirement removed Added

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			Proposals for a cable fault indicator that provides earth fault and overcurrent fault indication for 3x single core, and 1x three core terminations shall be provided as part of a tender submission. **3.5.2 Construction requirements** All enclosures standardised on a high risk design. **3.5.2.1 Construction requirements Type A** Provision of two incoming cables up to 185mm^2 changed from 300mm^2 cables Cable support clamps size changed from 50-100mm to 50-75mm **3.6 Specific requirements for Type B mini-subs** IRTU Type B msubs removed. Not required at present will include in future. Focus is on IRTU freestanding RMU implementation. **RMU** Changed the cable termination requirement in RMU to align to for 3x single core cables up to 300 mm2 or 1x three core cable up to 185mm2 with cable support clamps ranges and no as follows Three cable support clamps with range taking of 25mm-50mm and one clamp with range taking of 50mm-75mm shall be fitted and supplied in the RMU. **Added to RMU relay :** Relay shall trip with correctly rated matching CTs. and shall include i. Two configurable digital inputs (for external Trip input), ii. Fault event recorder capable of storing history of the last 5 events The relay shall only be settable via an external device, i.e. computer with configuration software. Configuration software shall be compatible with latest Windows operating system i.e. Windows 11 (64 Bit). Relay shall have include Inrush current detection blocking function. Removed current sensor options only CTs are allowed DST 32-335 replaced with 240-56063705 **LV circuit breakers** Removed LV switch disconnector option and standarised on LV circuit breaker option **4. Transformer losses and capitalization** Aligned the transformer cost formula variables to align with the latest revision of 240-68973110

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			5. Tests Transfer of Type Tests between OEMs. Removed this statement Added :All type testing shall be done at ILAC MRA accredited test facilities, unless otherwise permitted for specific transformers tests only. Previous only stated accredited local or international laboratories. **5.3.2 Additional testing IAC** Removed requirement for submitting supporting videos to type test reports. **Annexure A** Removed OEM specific protection device protection settings. Added 10kA short circuit current setting for 1000 kVA LV MCCB **Annexure B** Remove Technical Schedules A&B from std. Schedules to be published as separated spreadsheets.
Oct 2019	3	S. Mtshaulana	2.1: Removed corrosion requirements for inland application; only standardising on corrosion requirements for coastal application. 3.7.2e): Specified the required type test for IAC AB in accordance with IEC/SANS 62271-202. 3.3.1.4: Corrected the error on oil temperature gauge (98˚C to 105˚C). 3.1.2.2 Allowed for transformer design to be in accordance with 240-57648800 or 240-45395762. Annex A: Edited the relay protection settings to include 3.3 kV and 6.6 kV mini subs.
March 2016	2	Q. Khumalo / T.P. Du Plessis	Document revised to align with the latest template. Document now includes 3.3 kV and 6.6 kV mini subs. Updated normative references The transformer design requirements and top oil temperature protection setting allowance have been revised. Removed D-DT-0853. Included the additional technical requirements as stated in 12TB-03. Removed duplicate Technical Schedules A & B Clause 3.1.2.2 e) Proposals for the fitting of pressure relieve devices on all Type A and Type B mini-subs. Clause 3.1.2.3 f) Changed from two * 70 mm2 to three * 70 mm^2. Clause 3.1.2.3 g) Changed from two * 70 mm2 to three * 70 mm^2. Clause 3.1.2.4 Metering requirements for all Type mini subs added.

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			Clause 3.1.2.6 Rating tables revised for current ratings. Clause 3.1.2.8 g) Proposal for a fault current indicator Clause 3.1.3.1 J) Proposal for fitting of remote controlled door locking devices for IRTU fitted Type B mini subs. Clause 3.1.3.1 k) Proposal for alternative mechanical door locking devices and padlock protection facilities. Clause 3.2.1.1 The transformer bushing-centre spacing, and the distance between the outer bushing centres changed. Clause 3.3.1.1 c) i) & iii). Requirements for terminating three 1-core cable terminations added. Clause 3.3.1.1 c) iv. Minimum spacing between bushing centres and between the outer bushing centres have been revised. Clause 3.3.1.1 c) vi) The range of the cable support clamp have been revised. Clause 3.3.1.2 b) Requirement for MV interconnection added. Clause 3.3.2 c) Holding down bolt hole changed from 26 mm Ø to 24 mm Ø. Clause 3.10c) Added requirement for the supply of holding down bolts and nuts. Clause 3.7.2 Added the Eskom requirements for the SANS 62271-202 type test compliance for IAC AB Clause 3.7.3 Added the Eskom requirements for SSC's and MV cables Clause 3.10 b) Sealant strip requirement changed to poly-urethane or equivalent.
Jan 2013	1	B. Mwarehwa	DSP 34-1621 revised to align with the new artefact template. This document replaces DSP 34-1621. Document number changed.

13. Development team

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

a) N. Booyens: Distribution Tech & Eng

b) P. Mnomiya: Distribution Tech & Eng

c) S. Mtshaulana: SI GOU

d) B. Olivier: SI WCOU

e) J. Paulse: SI WCOU

f) T. Phali: SI ECOU

g) P. Almeida SI GOU

14. Acknowledgements

None

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Annex A – Protection Setting for Mini-subs

1. Protection settings for Type A & B mini-sub LV MAINS MCCB

The MCCBs protection settings shall be configured in accordance with the guidelines stated in table A1 below.

Table A1 Protection settings for the LV mains MCCB

Protection Function	200 kVA setting	315 kVA setting	500 kVA setting	1000 kVA setting
Overload current setting	300 A	450 A	800 A	1450A
Overload time delay setting or curve	Maximum or slowest curve settable on MCCB	Maximum or slowest curve settable on MCCB	Maximum or slowest curve settable on MCCB	Maximum or slowest curve settable on MCCB
Short circuit current setting (minimum)	3000 A	4500 A	8000 A	10000A
Short circuit time delay setting (maximum)	0,5 s	0,5 s	0,5 s	0,5 s

a) The transformer unit is fitted with a top-oil thermoelectric temperature-sensing element which trips the LV circuit breaker through a shunt-trip facility when the transformer top-oil temperature exceeds 105 ºC. This provides the main transformer overload protection facility. The long-time delay has been selected to maximum because it only acts as a backup to the main transformer overload protection. The settings also reduce spurious tripping due to acceptable overloading periods as the transformer is allowed to operate at 1.5 times its rated current for a limited period during cyclic loading in accordance with SANS 60076-5; and

b) The instantaneous time delay current and time are selected so as to allow protection grading with the downstream MCCBs especially for LPU applications where an equivalent sized MCCB may be installed downstream.

2. Protection settings for Type B mini-sub RMU circuit breaker relays

2.1 Relay supplied in Type B mini-subs

a) The primary current rating Is has been selected to allow for cyclic loading of the transformer in accordance with the SANS 60076-7 loading guideline applicable to SABS 780 transformers (i.e. allowing 1.5 x I rated for cyclic loading);

b) The main overload protection of the transformer will be provided by the top-oil temperature protection set in accordance with SANS 60076-7 loading guideline applicable to SANS 780 (i.e allowing up to 105 ºC top oil temperature);

c) The relay shall be tested in accordance with the following minimum requirements and a routine test certificate for the relay shall be produced and included with each mini-sub and stored in the documentation holder provide:

1) A primary current injection test shall be carried out to confirm the correct operation of the self-powered relay system (i.e. the CTs, the wiring and the relay settings). Primary current injection shall be carried out at 4 x Is and the tripping time shall be recorded. According to the HV-fuse characteristic this should result in a protection operating time in accordance with the table provided below. A tolerance of ±10 % is considered to be acceptable. The HV fuse characteristic is defined by the following equation:

$$Tripping\ Time\ (s) = \frac{a}{0.1}10^{((-3.832).\log\left(2\frac{I}{Is}\right)+3.66\ )}$$

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Where: a = Time multiplication factor (=3)

I = Fault current (A)

Is = Pickup Current (A)

$I_s = 1.5 \times I_{rated}$ in accordance with the permitted cyclic overloading as stated in SANS 780.

2) It is the responsibility of the manufacturer to ensure that the correct CT is fitted; and

3) A routine check shall be included on the test certificate that confirms that the relay Protection settings have been applied and tested in accordance with this specification.

Table A2 Example of protection relay settings for 11 kV and 22 kV Type B mini-subs(WIC1-4)

	11 kV			**22 kV**		
Transformer size kVA	**315 kVA**	**500 kVA**	**1000 kVA**	**315 kVA**	**500 kVA**	**1000 kVA**
Nominal current (Ir) [A]	16.5 A	26.24 A	52.5 A	8.27 A	13.12 A	26.24 A
Primary Current Setting (Is) [A]	24.8 A	39.36 A	78.4 A	12.4 A	19.68 A	39.36 A
Injected primary current (I = 4 x Is)	99.4 A	157.46 A	224A	64A	78.8A	157.56A
Relay tripping time (s)	47.48 s	47.48 s	47.48 s	47.48 s	47.48 s	47.48 s

Table A3 Protection relay settings for 3.3 kV and 6.6 kV Type B mini-subs

	3.3 kV		**6.6 kV**	
Transformer size kVA	**500 kVA**	**1000 kVA**	**500 kVA**	**1000 kVA**
Nominal current (Ir) [A]	87.48 A	174.95 A	43.74 A	87.48 A
Primary Current Setting (Is) [A]	131.22 A	262.43 A	65.61 A	131.22 A
Injected primary current (I = 4 x Is)	524.88	1049.7	262.44	524.88
Relay tripping time (s)	676.13 s	676.13 s	676.13 s	676.13 s

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