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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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] 240-75655480 (DSP 34-1080): Specification for earth fault indicators used for MV cable networks.

[4] 240-75655504: Corrosion protection standard for new indoor and outdoor Eskom equipment, components, materials and structures manufactured from steel standard.

[5] 240-97690165 (DSP 34-2123): Specification for telecontrol requirements for ring main units

[6] 240-64685228 (DST 34-333): Generic Specification for Protective Intelligent Electronic Devices (IEDS).

[7] 240-45395762: Specific requirements for distribution pole and ground-mounted transformers up to 33 kV and 1 MVA

[8] 240-70413291 (DSP 34-253): Specification for electrical terminal blocks

[9] 240-56065202: Switchgear Training Requirements from Original Equipment Manufacturers Standard

[10] 240-57648800: New oil filled auxiliary transformers rated 1 MVA and below and 33 kV and below

[11] SANS 1029, Mini-substations for rated A.C voltages up to and including 24 kV

[12] SANS 780, Distribution transformers

[13] SANS 1874, Switchgear — Metal-enclosed ring main units for rated a.c. voltages above 1 kV and up to and including 36 kV.

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

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

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

[17] SANS 1019, Standard voltages, currents and insulation levels for electricity supply.

[18] SANS 1091, National colour standard.

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

[20] 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.

[21] SANS 60529, Degrees of protection provided by enclosures (IP Code).

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

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

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

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

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

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

[28] 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.

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

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

[31] D-DT-0868, Schematic and wiring diagram

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

[33] D-DT-3034, LV circuit breakers

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

[35] D-DT-3132, Wire, meter sealing s/steel

[36] D-DT-3181, LV fuses

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

[38] D-DT-3196, Ferrule, tinned Cu sealing 12mm LG

[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-8016, Unscreened separable connectors (11kV)

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

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

[44] D-DT-8026, LV flexible cables

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

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

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

[48] D-DT-8052, Mini-substation 11 kV, Type A

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

2.2.2 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 extensible 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.
IRTU fitted Type B mini-sub	A miniature substation that is equipped with a ring main unit in the MV compartment and an IRTU control system.
IRTU	Integrated remote terminal unit that is fitted in or on the mini substation enclosure in accordance with requirements of 240-97690165 (Tele-control requirements for ring main units) and powered from the mini substation transformer
High risk Type B mini-sub	A miniature substation that is equipped with a ring main unit in the MV compartment and a high risk enclosure design.

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
IRTU	Integrated Remote Terminal Unit

Abbreviation	Description
Mini-sub	Miniature Substation
PECU	Photo-Electric Control Unit
RMU	Ring main unit
RTU	Remote Terminal Unit

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 mini subs

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.

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.

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. The specific requirements for Type A and Type B units are specified in sections 3.2 and 3.3.

The standard furthermore provides the requirements for IRTU fitted mini-subs where applicable.

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.

3.1.2 Electrical requirements

3.1.2.1 Rated lightning impulse peak withstand level

The rated lightning impulse peak withstand level for all 12 kV equipment shall be in accordance with “List 3” of table 1 given in SANS 876.

The rated lightning impulse peak withstand level for all 24 kV equipment shall be in accordance with “List 2” of table 1 given in SANS 876.

3.1.2.2 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 rated lightning impulse withstand voltage level for all MV equipment shall be in accordance with “List 3” of SANS 1019.

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

e) Proposals for the fitting of pressure relieve devices on all Type A and Type B mini-sub transformers will be required at the time of tender. The proposal for Eskom review shall include, the safe venting methodology, electronic indication and tripping of the RMU in the event of the pressure relieve device operation, and the testing thereof.

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

3.1.2.3 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 70 mm^2 copper 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 insulated jumper is connected 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 electrolytic copper conductors of cross-sectional area of at least 70 mm^2 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 electrolytic copper conductors of cross sectional area of at least 70 mm^2 each shall be fitted to provide an electrical bridge between the cable gland plate support structure and the LV neutral bar. Alternative copper conductors having an equivalent total cross sectional area may be accepted.

g) For mini-substations of rating 1000 kVA, three insulated electrolytic copper conductors of cross sectional area of at least 70 mm^2 each shall be fitted to provide an electrical bridge between the LV neutral bar and LV earth bar. Alternative copper conductors having an equivalent total cross sectional area may be accepted.

h) The neutral terminal of the transformer LV winding shall be connected to the LV neutral-earth or LV neutral bar.

3.1.2.4 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. 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.

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.

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.

3.1.2.4.1 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.

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.

3.1.2.4.2 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.

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.

3.1.2.4.3 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 a.c. (phase-to-neutral) and 360 V d.c.
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

3.1.2.4.4 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.

3.1.2.4.5 Meter, data concentrator and metering modem

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

3.1.2.4.6 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.

e) Only JST type YNT or Cembre type HP4 crimping tools shall be used for the crimping of lugs.

3.1.2.4.7 Antenna hole

a) A 22 mm diameter hole fitted with a rubber / plastic cover shall be provided on the side of the minisub for

the fitment of an external antenna for the metering modem.

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

3.1.2.5 LV assembly

a) The LV assembly shall be fitted with LV phase and neutral busbars as shown in figures 1 and 2.

b) The LV panel shall be constructed and designed 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 Type A mini-subs of rating up to and including 500 kVA, the LV assembly shall be designed to accommodate a minimum of five outgoing LV cable feeder bays.

d) In the case of Type B mini-subs of rating up to and including 500 kVA, the LV assembly shall be designed to accommodate a minimum of six outgoing LV cable feeder bays.

e) In the case of Type A and Type B mini-subs of rating up to and including 500 kVA, the LV assembly shall be fitted with an integrated metering infrastructure design (i.e. not a separate panel as used in 1 MVA mini-subs) in accordance with the drawing D-DT-1013 and clause 3.1.2.4.

Notes:

1) The main meter and modem will be supplied by Eskom.

2) A data concentrator or smart meter may be supplied by Eskom and be fitted in the place of the meter.

f) In the case of mini-subs of rating 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.

g) 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 cable used to connect the MCCBs from the LV busbars shall be in accordance with the requirements of D-DT-8026. MCCBs shall be fitted with individual inter-phase flash barriers. 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).

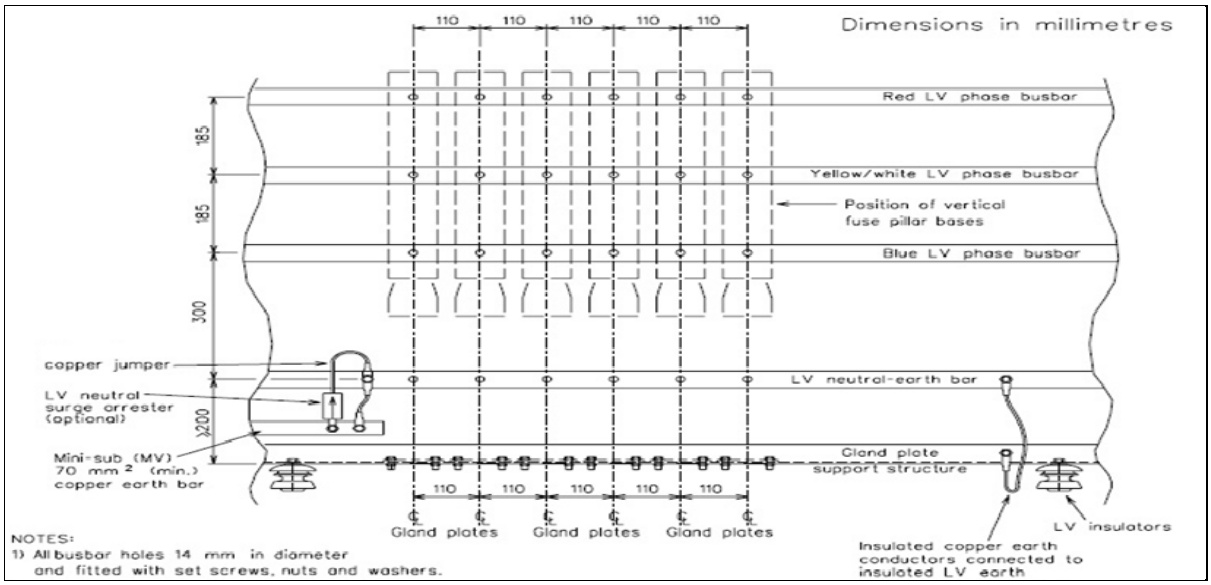

Figure 1: LV panel showing busbar and gland plate arrangement (mini-subs of rating up to and including 500 kVA)

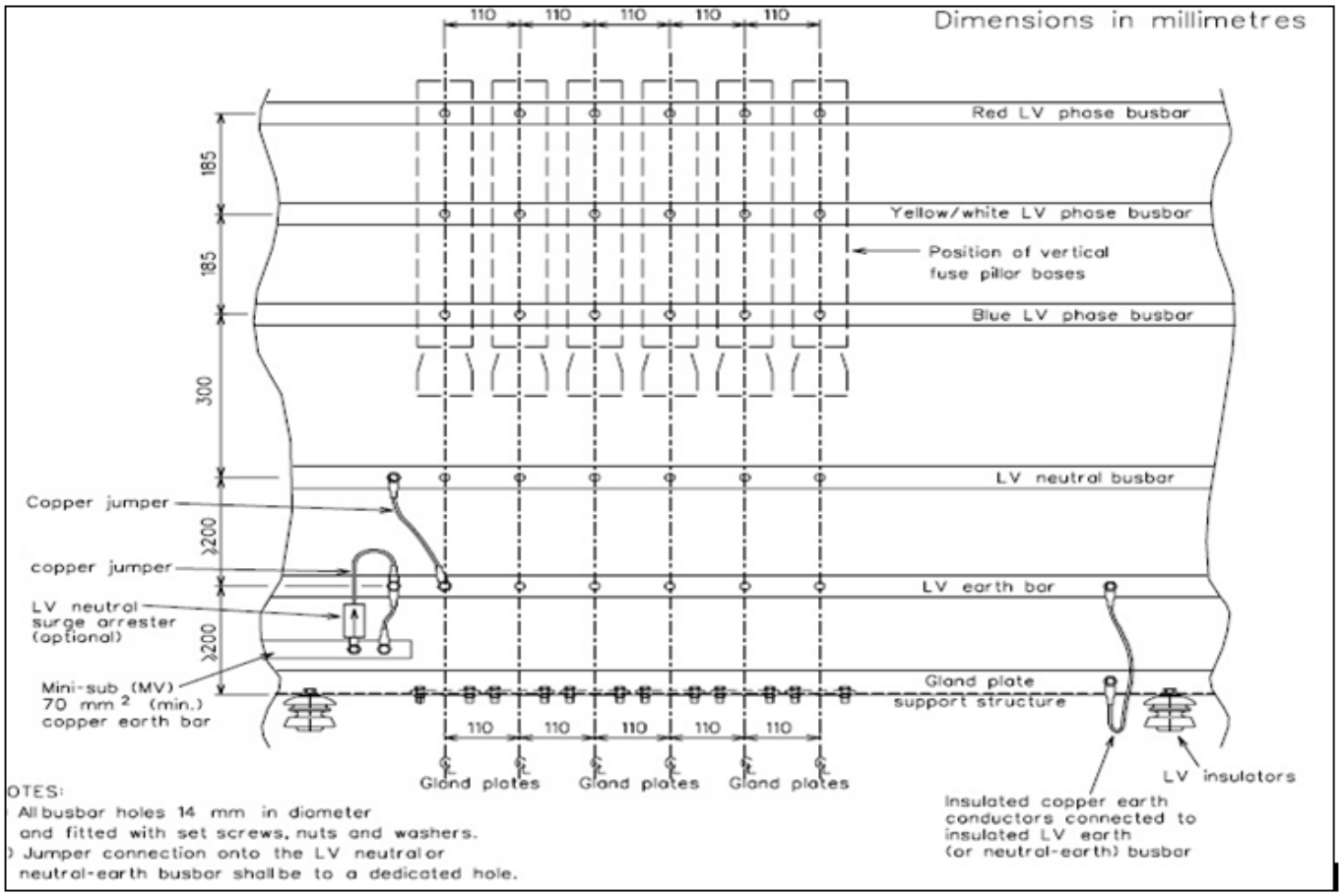

Figure 2: LV customer panel showing busbar and gland plate arrangement (mini-subs of rating 1000 kVA)

3.1.2.6 LV busbars

a) 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 2.

Table 2: LV busbar current ratings

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

b) 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.

3.1.2.7 LV gland plate arrangement

An 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.

3.1.2.8 LV auxiliary equipment

The following LV auxiliary equipment shall be provided

a) 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.

d) A removable 3CR12/stainless steel blank mounting plate shall be provided in the LV compartment for the installation of street lighting Photo Electric Control Unit (PECU) as and when required. The minimum plate dimensions shall be approximately 300 mm x 300 mm and it shall be located as near as possible to or adjacent to the photocell compartment.

e) 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.

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 240-75655480 (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. An EFI status output will be required for IRTU fitted mini-subs.

g) Proposals for a fault current indicator positioned on the right-hand side of the MV compartment and with the current sensors fitted to the left-side ring cable that can detect phase to phase and three phase fault currents on Type B mini-subs will be required at the time of tenders.

3.1.2.9 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.

d) The LV panel 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.

3.1.3 Construction requirements

3.1.3.1 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.

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) The three-point locking mechanism on each compartment door shall have an additional, captive, 10 mm Allen cap screw.

f) All door handles shall be classified as “heavy-duty” and shall be manufactured from stainless steel.

g) A padlock protection facility shall be provided for all mini-subs as shown in Figure 3.

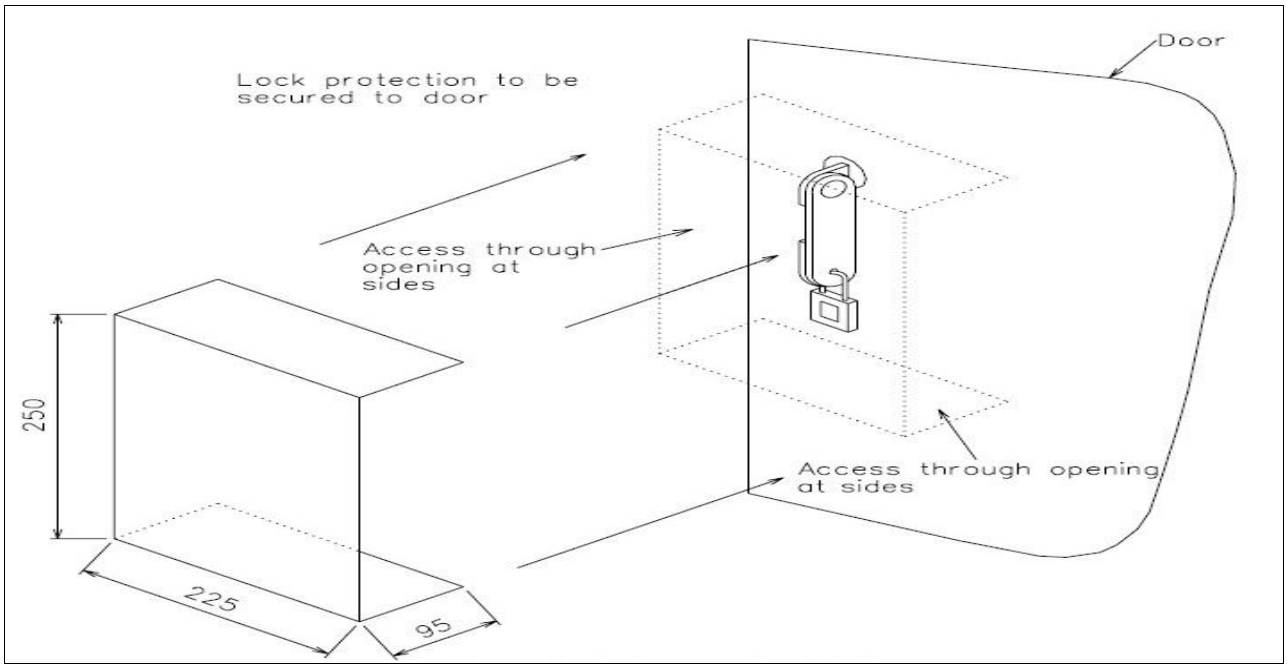

Figure 3: Padlock protection facility

h) The padlock protection facility shall provide access to the padlock from both sides.

i) 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.

j) If required during tenders, proposals for the additional fitting of remote controlled door locking devices may be required on IRTU fitted Type B mini-subs only. The proposal for Eskom review shall include: the operation of such locking devices in the event where the IRTU battery system and the mini-sub LV power is not available.

k) 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.

3.1.3.2 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 or zinc metal sprayed mild 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 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.

3.1.3.3 Additional requirements for "high-risk" mini-subs

Note: "High-risk" mini-subs refers to mini-subs intended for use in areas where the probability of vandalism is high – leading to potential safety risks as well as non-technical losses. The following additional requirements are required only for mini-subs classified as "high-risk" – as requested by the Eskom divisional operating units.

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

b) The mini-sub enclosure, doors and lock protection facilities shall be manufactured using 6 mm thick steel (refer to technical schedules).

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

d) Heavy duty hinges shall be fitted for the doors.

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

f) For IRTU fitted mini-subs additional electrical locking mechanisms and door alarm sensors may be required.

3.2 Specific requirements for Type A mini-subs

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

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

b) A transformer compartment housing the transformer; and

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

3.2.1 Electrical requirements

3.2.1.1 Transformer MV bushings

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.

3.2.1.2 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.

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 stainless steel meter sealing wire (see D-DT-3132) and a 12 mm tinned copper ferrule (see D-DT- 3196).

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. Digital gauges may be required for IRTU fitted mini-subs and will be subject to approval by Eskom. 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

3.2.2 Construction requirements

3.2.2.1 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 in the MV compartment. Two cable clamps (see D-DT-8019) shall be provided with the mini-sub in accordance with SANS 876. The distance from the cable support point (clamp) to the transformer bushing centres shall be at least 800 mm. The cable support clamps shall be range taking for cables with outer diameters of 50 – 100 mm. The clamps shall be securely fitted.

c) The transformer bushings shall be horizontally positioned in a straight line.

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

e) The MV compartment shall have a minimum internal width of 700 mm.

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

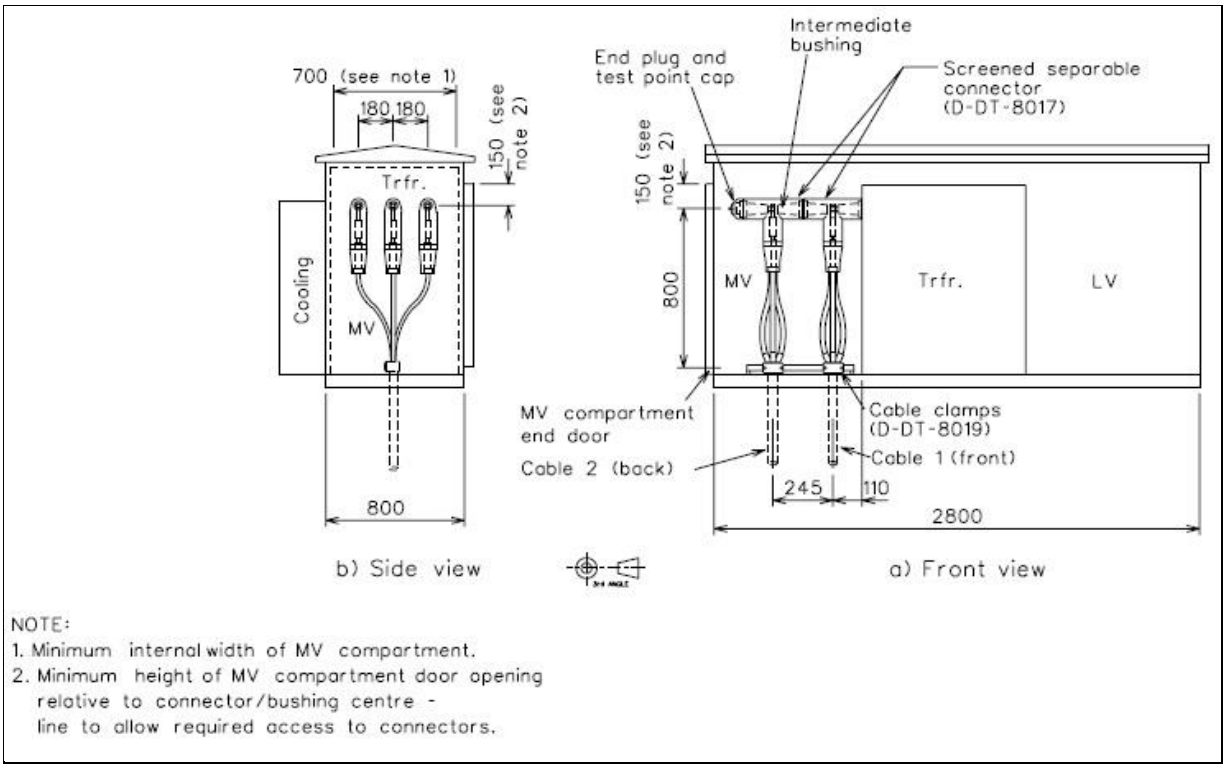

Figure 4: 11 kV and 22 kV Type A mini-sub of rating up to and including 500 kVA

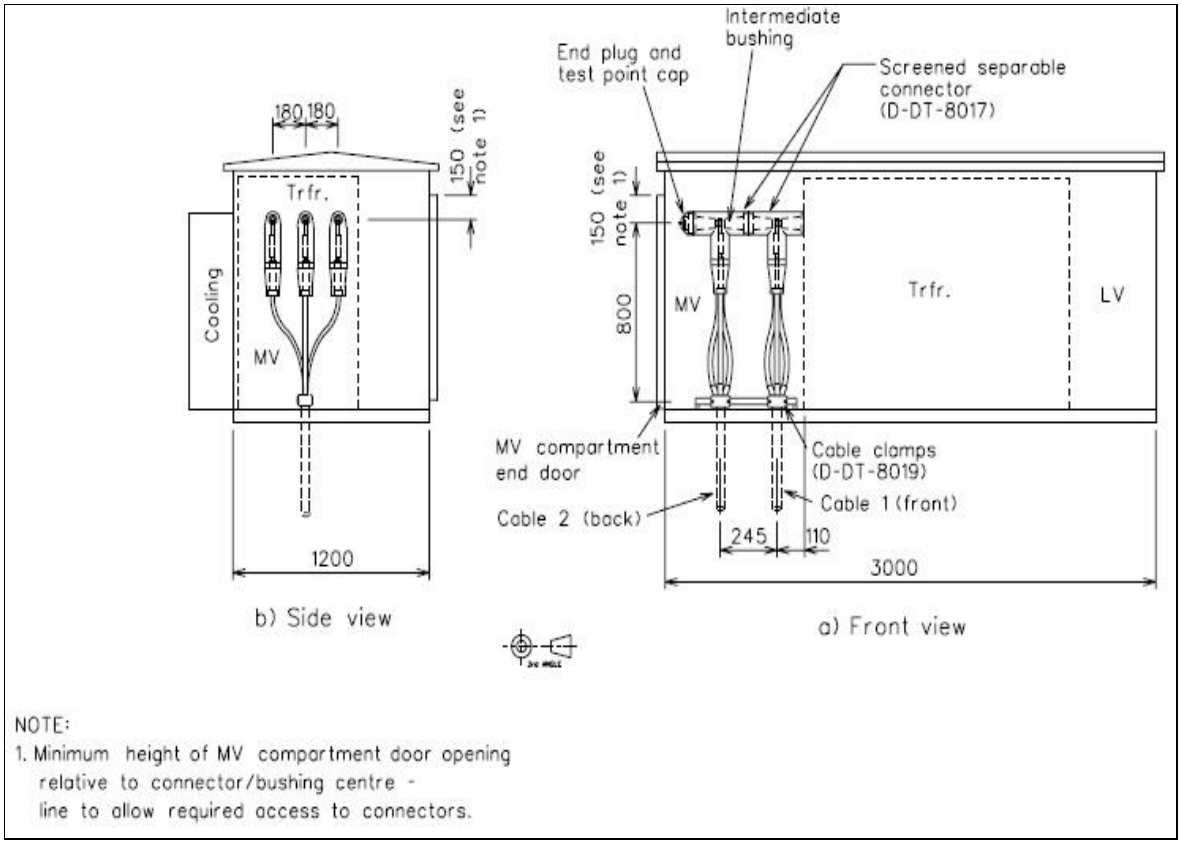

Figure 5: 11 kV and 22 kV Type A mini-sub of rating 1000 kVA

3.3 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; or a medium-voltage compartment that is fitted with a non-extensible '2R-1B' ring main unit and IRTU in accordance with 240-97690165. For the IRTU fitted mini-subs the power supply shall be connected from the mini-sub transformer with a suitable designed fuse arrangement in the mini-sub LV compartment;

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; and

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

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.

3.3.1 Electrical requirements

3.3.1.1 MV ring main unit (RMU)

The ring main unit and IRTU fitted / connected ring main unit shall comply with the requirements of SANS 1874 and the following:

a) Integral cable test facilities that do not require access to the cable termination enclosure (i.e. are independent of the cable termination enclosure) shall be provided for all 'R' functions (switch-disconnectors). Each cable test facility shall be interlocked with its associated earth switch to ensure that the test terminals of the cable test facility are not accessible when the cable is energized. The cable test facility need not be capable of being padlocked. Working instructions shall be provided on each RMU for the correct reinstatement procedure of the earth connection on the cable test facilities after cable testing.

b) Remote tripping, opening, closing and earthing via a hand-held push-button remote control unit:

   1) Provision is required for remote tripping and closing via a hand-held push-button remote control unit on all functional units and their respective operational functions (i.e. trip, open, close and earth pendant control where applicable), it will be specified in schedule A.

   2) The plug-in connector for the hand-held remote control unit shall be a circular bayonet type coupler. Details of connector shall be specified in schedule A. The male coupler shall be provided and positioned on the front of the ring main unit.

   3) Details of the provisions offered for remote tripping, opening, closing and earthing via a hand-held push-button remote control unit shall be given in schedule B (e.g. stored energy mechanism with latching functions / motorised mechanism, additional trip/close coils, portable battery tripping unit (BTU) power supply specification, BTU charging requirements). The hand held remote tripping, opening, closing and earthing shall be possible when the mini substation transformer is not energised.

c) Ring main unit cable termination enclosures

   1) The ring main unit cable termination enclosures shall be suitable for the termination of 3-core cables of conductor cross-sectional area up to 300 mm^2 size or for the termination of three 1-core cables of conductor cross-sectional area up to 300 mm^2 size where applicable.

2) The cable support clamp shall be suitable to clamp either a 3 core cable up to 300 mm^2, or 3x1-core cable up to 300 mm^2.i.e one clamp for each core Thus the clamp should be able to accommodate a cable range from 25 mm to 100 mm.

3) Three cable clamps of range 25 mm to 100 mm shall be supplied for each RMU cable termination compartment.

4) The cable termination enclosure for 3-core cable terminations shall have a 800 mm minimum bushing centre line spacing distance to the bottom cable entry or bottom entry plate.

5) The cable termination enclosure for the three 1-core cables shall have a minimum bushing centre line spacing distance to the bottom cable entry or bottom entry plate to ensure the single core termination lengths as specified in SANS 876 can be fitted.

6) For 3.3 kV, 6.6 kV and 11 kV an 11 kV ring main unit shall be used. For the 11 kV ring main units, the minimum spacing between bushing centres and between the outer bushing centres and earthed metal enclosure shall be 105 mm and 55 mm respectively. Where screened separable connectors are used for the tee-off circuit-breaker compartments, the minimum spacing between bushing centres and between the outer bushing centres and earthed metal enclosure of the tee-off circuit-breaker shall be 90 mm and 50 mm respectively. Technical deviations for the 11 kV spacing between bushing centres and between the outer bushing centres and earthed metal enclosure shall be submitted for Eskom review and consideration.

Note:

- These dimensions are based on the fact that for the ring main unit cable terminations at 11 kV, unscreened separable connectors are still used in Eskom divisional operating units. Should screened separable connectors be used in future at 11 kV, the dimensions specified for 22 kV ring main units may be applicable.
- An 11 kV RMU shall be used for 3.3 kV and 6.6 kV mini subs.
- The design for 11 kV mini subs shall be used for both the 3.3 kV and 6.6 kV mini subs.

7) For 22 kV ring main units, the minimum spacing between bushing centres and between the outer bushing centres and earthed metal enclosure shall be 90 mm and 50 mm respectively.

Note: These dimensions are based on the fact that at 22 kV, screened separable connectors are used in Eskom divisional operating units. The dimensions are based on the physical dimensions of screened separable connectors.

d) An “integrated” voltage detection system (VDS) with fixed voltage indicators and test points in accordance with SANS 61243-5 shall be provided for each functional unit. These VDS units are required to be fully functional when the mini substation transformer are not energised, this may also be required as part of compliance to SANS 1874 clause 4.3.5.4 if the VDS is used for the required cable test facility interlocking.

e) Circuit breaker protection relay

1) The protection tripping of the circuit breaker shall be through a self-powered protection relay.

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).

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.

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, current sensors or current transformers shall be installed and wired complete for service.

11) The wiring from the protection relay to the current sensors or current transformers shall be in accordance with DST 32-333 unless otherwise approved by Eskom.

12) Once the relay has been set, it shall be sealed with a stainless steel meter sealing wire (see D-DT-3132) and a 12 mm tinned copper ferrule (see D-DT-3196) to indicate evidence of tampering.

f) Gas density monitoring device

1) The device provided for monitoring the gas pressure on each tank shall respond to gas density (i.e. shall indicate pressure compensated for temperature).

2) If it is specified in schedule A that an IRTU is to be supplied for remote monitoring and control, a density monitoring device (which may be integrated into the temperature compensated pressure gauge as a dual function device) shall be provided with contacts which shall operate in two stages as follows:

- On reaching the non-urgent alarm / warning level (i.e. where gas pressure is low but live switching is still possible);
- On reaching the critical level (i.e. where live switching can no longer be performed and switchgear is to be taken out of service).

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

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

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

6) When provided, the density monitoring device shall also give a positive and reliable response on reaching the operating values (the reliability of the density monitoring device shall not be negatively affected by the effect of contact bounce).

3.3.1.2 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.

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

3.3.1.3 Transformer MV bushings

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.

3.3.1.4 Transformer overload protection

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 (see D-DT-3132) and a 12 mm tinned copper ferrule (see D-DT-3196).

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.

3.3.1.5 LV main switch-disconnector or LV main breaker

a) For mini-subs of rating up to and including 500 kVA, a main LV switch-disconnector shall be provided in the LV end compartment in order to isolate the LV busbars from the transformer. The type (i.e. make / product) of switch-disconnector offered shall be stated in schedule B.

b) For mini-sub of rating 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.

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

Table 4: Standard LV switch-disconnector / circuit breaker ratings

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

3.3.1.6 Remote control and monitoring of mini-sub (if applicable)

a) If specified in schedule A, the mini-sub shall be supplied and fitted with an integrated remote terminal unit (IRTU) for remote monitoring and control of the RMU.

b) The IRTU shall comply with the requirements of 240-97690165 and SANS 1874.

c) The IRTU shall be mounted in a suitable enclosure attached to the MV side of the mini-sub enclosure

d) The IRTU auxiliary supply shall be provided from the LV busbars of the mini-sub.

e) The 230 $V_{a.c}$. auxiliary supply for the IRTU shall be fitted with the following:

1) a suitably rated HRC fuse; and

2) a neutral fuse link.

3.3.2 Construction requirements (3.3 kV, 6.6 kV, 11kV and 22kV Type B mini-subs)

a) For mini-subs designed for the fitting of LV circuit breakers, the LV assembly (i.e. busbars, circuit breaker mounting plate, barricades, gland plate support structure etc.) shall be at least 1000 mm in length to allow 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.

b) The LV busbars and gland plate support structure shall be pre-drilled for the full 1000 mm length (at 110 mm centres) to allow for up to 9 feeder bay positions in accordance with SANS 1029.

Note: Although the gland plate support structure will provide for up to 9 gland plate positions, only 6 gland plates need to be provided.

c) Provision for holding down the outdoor mini-sub

The mini-sub base shall have four 24 mm Ø round mounting holes dimensioned and positioned in accordance with D-DT-0859.

3.3.3 Ring main unit protection relay settings and testing

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

Table A1 and table A2 (Annex A) lists the protection relay settings of the Type B mini subs for all sizes of Type B mini subs.

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

3.4 Additional general requirements for 1000 kVA mini-subs

3.4.1 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.

b) The LV compartment shall be divided into three sub-compartments (see figures 6) as follows:

1) Eskom panel (mini-sub end compartment);

2) Metering and control panel (right-hand side LV compartment door); and

3) Customer panel (left-hand side LV compartment door).

c) Access to each LV sub-compartment shall be by way of an individual door that is lockable.

d) Barricades shall be used to prevent access between sub-compartments.

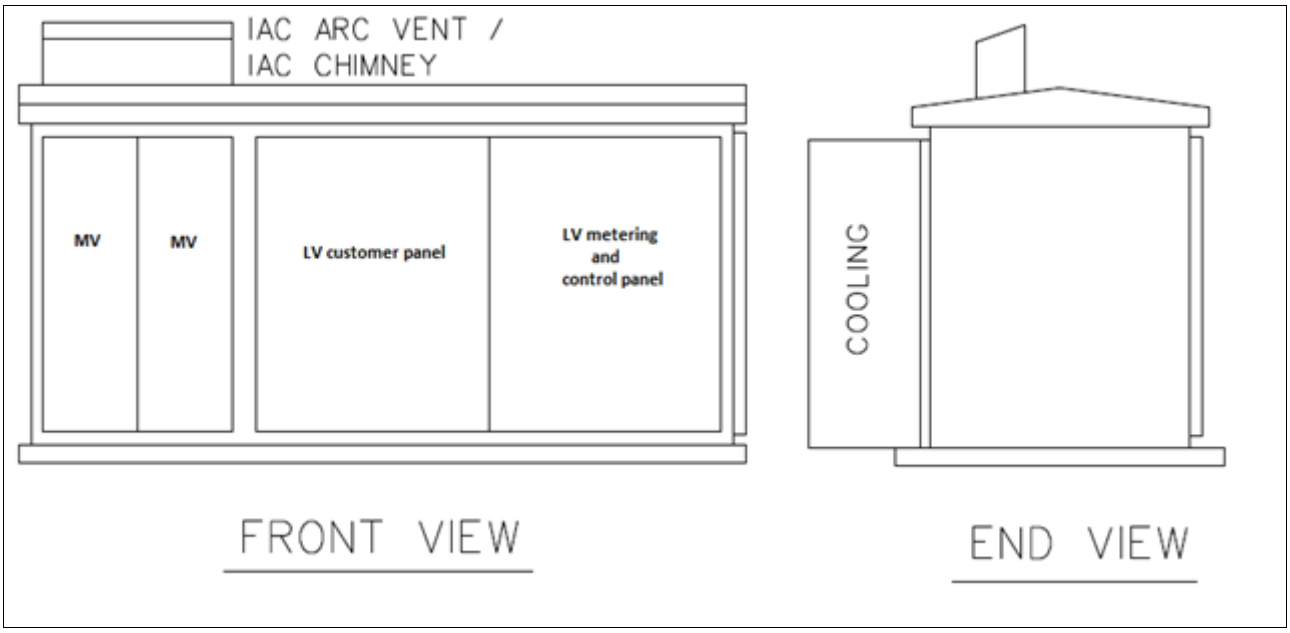

Figure 6: 1000 kVA Mini-sub housing design

3.4.2 LV Compartment

3.4.2.1 Auxiliary wiring

All auxiliary wiring in the LV compartment 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.

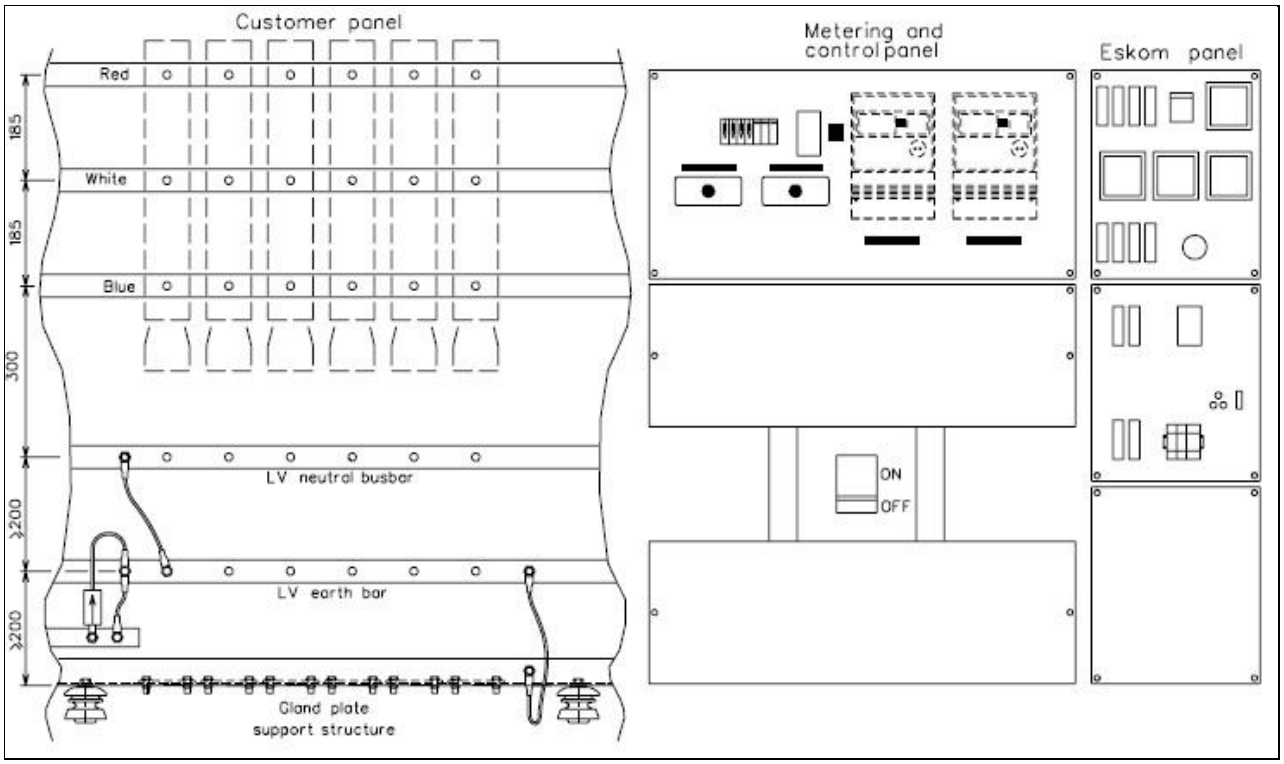

Figure 7: LV assembly design – modified metering panel based on latest revisions of D-DT-1013

3.4.2.2 Eskom panel

The following equipment shall be fitted in the Eskom panel (see figure 7):

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;

d) Earth fault indicator (EFI) LV supply ;

e) Transformer overload protection facility as specified in 3.2.1.2.b and 3.3.1.4.

3.4.2.3 Metering and control panel

The metering and control panel is in figure 7 and D-DT 1013.

a) A 1600 A main LV circuit-breaker shall be provided at the bottom of the panel in order to isolate the LV busbars from the transformer. The connections onto the circuit-breaker on the line and load side shall be barricaded using removable metallic barriers.

b) See clause 3.1.2.4 for all requirements.

3.4.2.4 Customer panel

Customer panel is shown in figure 7.

a) The LV busbars, earth bars and a gland plate arrangement shall be fitted in the LV customer panel as shown in figure 2.

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.

3.4.3 LV main circuit breaker protection relay settings

Where applicable for 1 MVA and all Type A mini-subs 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. The protection relay shall be installed, completely wired and ready for commissioning prior to delivery to Eskom.

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

3.4.4 MCCB mounting plate details

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 8.

The corrosion requirements for the MCCB mounting plate shall be manufactured in accordance with clauses 3.1.3.2

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

- Aperture = 7 mm
- Pitch of Aperture = 17 mm
- Thickness of material = 3 mm
- Minimum perforated area for Type B, L X W = 940 mm X 295 mm
- Minimum perforated area for Type A, L X W = 510 mm X 295 mm

Note: Eskom no longer accepts MCCB mounting rails for the LV MCCB mounting equipment which can only accommodate MCCBs having the same frame size.

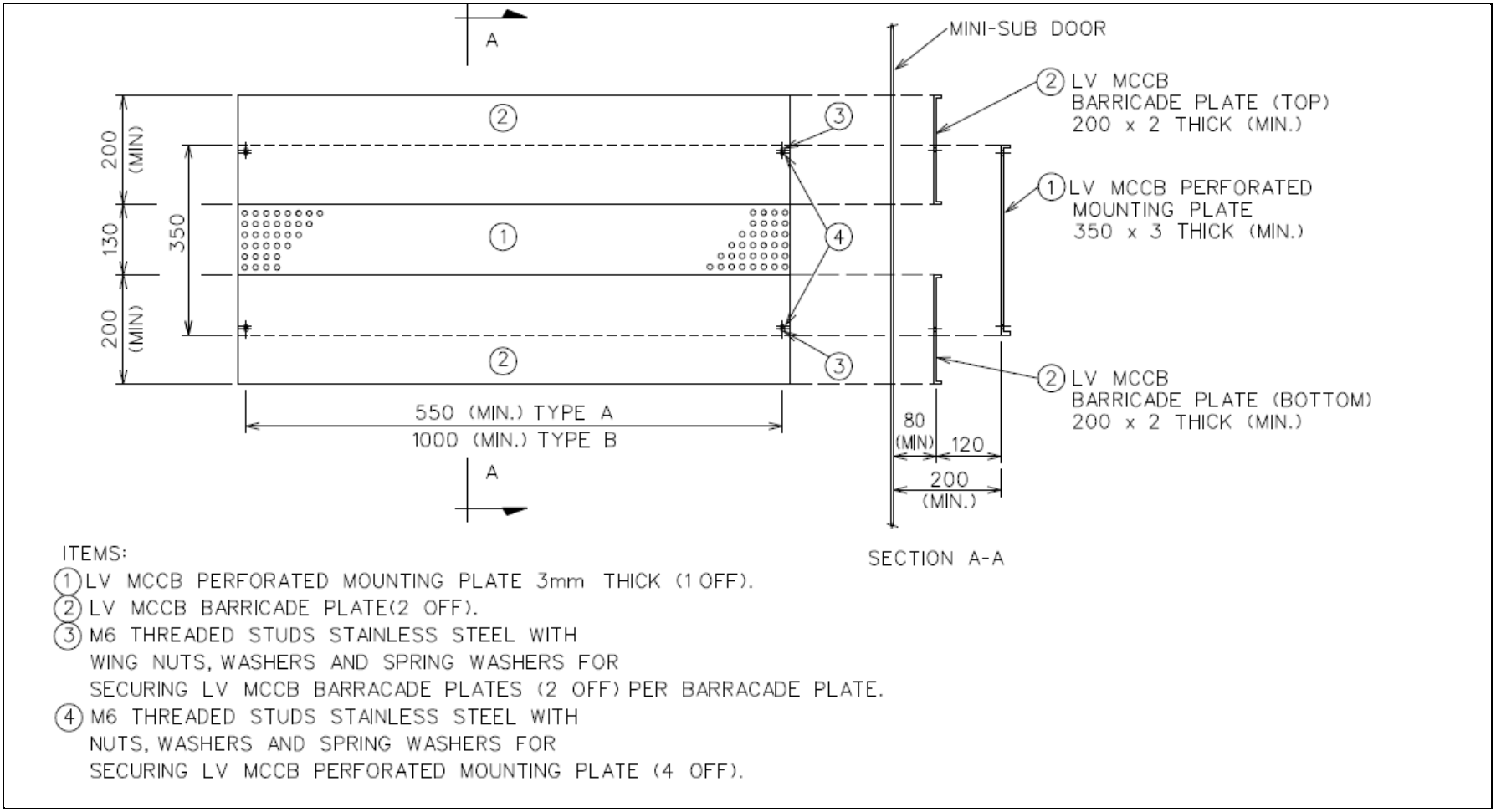

Figure 8: LV MCCB mounting details

3.5 Transformer losses and capitalization

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

$$\text{Total cost} = A + C_i P_i + C_c P_c$$

Where:

- A: is the cost of purchasing and installing the transformer (capital cost), R;
- P_i: is the no-load (iron) losses, kW;
- P_c: is the load (copper) losses, kW;
- $C_{i:}$ is the capitalized cost of no-load (iron) loss, R/kW; and
- $C_{c:}$ is the capitalized cost of load (copper) loss, R/kW.

b) The economic life of a transformer is assumed to be 25 years.

c) The values of parameters Ci and Cc are given in the technical schedules. These parameters will be revised with each enquiry.

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

e) 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.

f) A loss evaluation in accordance with 240-57648800 or 240-45395762.

3.6 Tests

3.6.1 General

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. The supplier or manufacturer shall demonstrate an ability to provide means to enable Eskom to witness such tests.

b) Type tests are intended to establish design characteristics. They are normally only made once and repeated only when the design, components, material or manufacturing location of the unit or its components are changed. The results of the type tests are recorded as evidence of compliance with design requirements.

c) Suppliers shall submit all the required type test reports. If the units offered have been tested for compliance with an internationally accepted standard, Eskom may accept those test reports in place of the tests covered by this specification. These type test reports and alternative test standards shall be submitted with the tender, for Eskom's consideration.

d) The qualifying type tests need not be performed if they were successfully completed on a previous Eskom tender, provided that the design and material have not been changed or modified in any way. The type test certificates of completed successful type tests previously submitted shall be submitted with the current tender. Any change in the components shall be indicated at the time of tender.

e) The transfer of test certificates between manufacturers will not be allowed.

f) The supplier shall ensure that type tests are valid.

g) 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 representative of the purchaser, on a sample unit of the mini-sub in question. These tests shall be at the expense of the supplier.

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

3.7 Qualifying tests

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. 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. All type testing shall be done at accredited local test facilities (SANAS accredited – e.g. SABS) or accredited international testing authorities/facilities (e.g. KEMA/CESI/IPH), unless otherwise permitted for specific transformers tests only.

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.

The minimum qualifying 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 to 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 must be witnessed by a suitable Eskom technical representative.

3.7.1 Transformer temperature rise test

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:

- Top oil- temperature rise 55° K
- Average winding temperature rise 60° K
- Hot spot temperature rise 73° K

In addition, the transformer rated current (and thus load-losses) shall be increased by 5 % when carrying out the temperature rise test.

Note: 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 400 V.

3.7.2 Internal arc classification test for Type B mini-subs

As per the requirements of clause 6.2.6 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:

a) 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.).

b) 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.

c) All the related SANS/IEC 62271-200 and SANS/IEC 62271-202 compliant type test reports and type test videos applicable for the selection of tests on HV switchgear for the proof of class IAC-A and IAC-B in figure AA.4 and figure AA.5 in accordance with SANS/IEC 62271-202, shall be submitted for the Eskom safety review and technical evaluation. This shall include the applicable type test reports and videos for each RMU manufacturer option offered where applicable, and each mini-sub enclosure manufacturer design and RMU manufacturer option offered. These type test reports and videos will be reviewed and evaluated to ensure safe installation and operating procedures are implemented by Eskom for the internal arc venting behaviour observed as part of the Eskom Zero harm values.

d) All compliant type test reports and the corresponding videos for all applicable IAC AB tests performed in accordance with SANS/IEC 62271-202 and SANS/IEC 62271-200 for the Mini-sub and RMU combinations, and each RMU offered shall be supplied for the Eskom safety review in clause (c) above.

e) If IAC AB 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.

3.7.3 Screened separable connectors and MV cables

The make and type of screened separable connectors and MV cables offered in accordance with DSP 34-1622 and SANS 1029 shall be stated, and the relevant type test reports, drawings and installation instructions in accordance with SANS 1332 and SANS 1029 shall be submitted as part of tender evaluations.

3.8 Marking, labelling, packaging and transport

3.8.1 Marking and labelling

3.8.1.1 Mini-sub rating plate information

In addition to the mini-sub rating plate, the following statement shall be included “MANUFACTURED TO ESKOM SPECIFICATION 240-56062752”.

3.8.1.2 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 Type B mini-subs, the sign shall be attached to the inside of the door that opens first.

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 doors. 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.

3.8.1.3 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 back 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.

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,

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

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

3.8.2 Documentation

3.8.2.1 Technical schedules and test schedules

The full Technical Schedules B (including the Test Schedules and the Deviation Schedules) shall be completed and submitted to Eskom together with the Technical Schedules A for approval at the time of tendering. This will include the individual mini sub item Technical Schedules, the individual transformer design technical schedules, the individual RMU item technical schedules where applicable for Type B mini subs, and the individual IRTU item technical schedules for IRTU fitted Type B mini subs.

3.8.2.2 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.

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 (see 3.8.1.3 e) shall be supplied by the supplier for approval.

3.8.2.3 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.

3.9 Spares

A spares proposal for all type mini-subs shall be listed and shall be submitted during tender submissions for Eskom review.

3.10 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. 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.

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.

c) Each 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.

3.11 Training

A training proposal for the installation, operation and maintenance of all type mini-subs and their associated main components (i.e. Mini-sub, RMU, IRTU 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.

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

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
Bheki Ntshangase	HV Plant: Senior Manager
Jacques Paulse	MV/LV Cable Systems CG: Convener

5. Revisions

Date	Rev	Compiler	Remarks
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.

Date	Rev	Compiler	Remarks
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. 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.

Date	Rev	Compiler	Remarks
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.

6. Development team

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

- N. Booyens: DBOUS SI KZNOU (Senior Engineer)
- Q. Khumalo: PDE HV Plant (Chief Engineer)
- S. Mtshaulana: DBOUS SI GOU (Engineer)
- B. Olivier: DBOUS SI WCOU (Senior Technician)
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7. Acknowledgements

The author acknowledges the team which developed the first revision of the document.

Annex A – Protection Setting for Mini-subs

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

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

Table A.1: 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	
Short circuit time delay setting (maximum)	0,5 s	0,5 s	0,5 s	0,5 s

Notes:

1) 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.

2) 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 WIC1-4 relay supplied in Type B mini-subs

a) The protection relay shall be in accordance with 240-64685228 and application of Protection settings shall not be possible via external switches (DIP / Dials).

Notes:

1) The WIC1-W2 CTs are to be fitted for the WIC1-4 relay.

2) The primary current rating I_s 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).

3) 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 ^{o}C top oil temperature).

4) The earth fault current protection parameters have been selected to prevent spurious earth fault tripping due to a false earth fault detection resulting from the DC component of transformer inrush currents while energizing the transformer.

b) 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 provided:

i. A primary current injection test shall be carried out to confirm the correct operation of the relay (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:

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

Where: a = Time multiplication factor (=3)

I = Fault current (A)

Is = Pickup Current (A)

i. The CTs to be fitted for the WIC1-4 and WIC1-W2 relays for 11kV and 22kV applications are not the same as the ones used for 3.3kV and 6.6kV applications. It is the responsibility of the manufacturer to ensure that the correct CT is fitted.

ii. 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.

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

Table A.2: Protection relay settings for 11 kV and 22 kV Type B mini-subs

	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	56 A	16 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

Annex B – Protection Requirements

1) Protection settings for 1000 kVA mini-sub LV main circuit breakers

a) Schneider Merlin Gerin NS1600N, ABB T7S1600 and ABB S7S1600 LV main circuit-breakers used on 1 MVA mini-subs

Type B mini-subs having the VIP 35 relay (supplied with the Merlin Gerin RM6 “IDI” type RMU) shall only be fitted with Merlin Gerin NS1600N LV main circuit-breaker.

Notes:

1) It is not possible to provide complete protection co-ordination between the VIP 35 RMU relay and the ABB LV main circuit-breaker options.

2) The VIP 35 relay is set to provide the maximum allowable over-load current (i.e. 1,8 x rated transformer current) in accordance with SANS 60076-7. It is not recommended that the VIP 35 relay current settings be increased to allow any over-load currents greater than this.

Type B mini-subs having the WIC 1-2 relay (supplied with the ABB Safering CCV type RMU) shall be fitted with the Merlin Gerin NS1600N, ABB T7S1600 or the ABB S7S1600 LV main circuit-breaker.

b) Merlin Gerin NS1600N settings

The “Micrologic 2.0” control unit supplied in the Merlin Gerin NS1600N shall be configured in accordance with settings specified in table B.1.

Table B.1: Micrologic 2.0 protection settings for 1 MVA mini-sub

Protection function	Type A mini-sub	Type B mini-sub
	1000 kVA	**1000 kVA**
Ir (nominal current setting)	1600 A	1600 A
“Ir” Long time current setting	1 (i.e. 1600 A nominal current setting)	1 (i.e. 1600 A nominal current setting)
“**tr**” Long time delay setting	24s	1s
“Isd” Instantaneous pickup current setting	i.e. 8 * 1600 A = 12.8 kA)	i.e. 8 * 1600 A = 12.8 kA)

c) ABB T7S1600 settings

The PR231/P electronic trip unit supplied in T7S1600 shall be configured in accordance with settings specified in table B.2.

Table B.2: PR231/P protection settings for 1 MVA mini-sub

Protection function	Type A mini-sub	Type B mini-sub
“Ir” Long time current setting	1 (i.e. 1600 A nominal current setting)	1 (i.e. 1600 A nominal current setting)
“**tr**” Long time delay setting	12s	3s
“Isd” Instantaneous pickup current setting	i.e. 8 * 1600 A = 12.8 kA)	i.e. 8 * 1600 A = 12.8 kA)

d) ABB S7S1600 settings

The PR211/P electronic trip unit supplied in the S7S1600 shall be configured in accordance with settings specified in table B.3.

Table B.3: PR211/P protection settings for 1 MVA mini-sub

Protection function	Type A mini-sub	Type B mini-sub
"I**1**" Function "L" trip threshold current.	1 (i.e. 1600 A nominal current setting)	1 (i.e. 1600 A nominal current setting)
"t**1**" Function "L" trip curve	Curve D or 18s	Curve B or 6s
"I**3**" Function "I" instantaneous trip threshold	i.e. 8 * 1600 A = 12.8 kA)	i.e. 8 * 1600 A = 12.8 kA)

Annex C – Technical Schedules A and B and Deviation schedule

Informative

Use of the technical schedules is intended to obviate the need for preparing a detailed technical specification for every enquiry. The purchaser need only specify compliance with 240-56062752 and provide the tenderers with the relevant schedules A and B.

Schedule A gives Eskom's requirements. It lists the requirements to be specified by the purchaser in enquiries and orders. These requirements may include references to the relevant sub-clauses in this document. Where the text of any referenced standard stipulates that the purchaser shall indicate his requirements, these requirements should also be specified in schedule A. The purchaser shall set out his particular requirements and choices in schedule A.

The purchaser shall require the tenderer to fill in schedule B. By doing this, the tenderer will state compliance with this document and provide the information the purchaser has requested. Schedule B shall be completed in full by the supplier.

Deviations/modifications/alterations from the requirements specified in Schedule A shall be well documented in the deviation schedule.

Price schedules shall be so drawn up and the covering letter so worded that the costs of all services such as tests and delivery are declared and allowed for in the tender.

Annex D – Generic Technical Schedules A and B For: Mini-subs

Technical Schedules A and B

Schedule A: Purchaser's specific requirements

Schedule B: Guarantees and technical particulars of equipment offered

TECHNICAL SCHEDULES A & B FOR 240-56062752						
SAP: Item specific Select item from list . . .						
Schedule A: Purchasers specific requirements						
Schedule B: Guarantees and technical particulars of equipment offered						
1	2	3	4	5	6	7
Item	**Document**	**Sub-clause**	**Description**	**Units**	**Schedule A**	**Schedule B**
1						
			Select item from list . . .			
1.1			**SAP Number**		**Item specific**	
1.2			Buyers Guide Drawing		Item specific	_____
			Mini sub Type		Item specific	_____
1.3	SANS 1029	4.2.1.3 a)	Altitude m	m	1800	_____
1.4			Nominal system voltage	kV	Item specific	_____
1.5	SANS 1029	4.2.1.3 b)	Relative humidity	(%)	98	_____
1.6	SANS 1029 & SANS 62271-1	4.2.1.3 d) and 2.1.2 a)	Ambient air temperature	'c	-10 to +40	_____

1.7	SANS 62271-1	2.1.2 b)	Maximum solar radiation	W/m2	1000	_____
1.8	SANS 62271-1	2.1.2 f)	Wind pressure	Pa	700	_____
			Ultra-violet radiation		High	_____
1.9	240-56062752	3.1.1 a) ii)	Pollution conditions inside mini-sub		Degree 3	_____
1.10	240-56062752	2.1	Mini sub application(Coastal)		xxxxxxxxxxx	_____
			Transformer Ratings			
2.1	240-56062752	3.1.2.1	Rated lightning impulse withstand kV peak	kV	Item specific	_____
2.2	240-56062752	3.1.2.2 a)	Transformer power rating	kVA	Item specific	_____
2.3	240-56062752	3.1.2.2 b)	Nominal voltage of system (Un) (kVrms)	kV	Item specific	_____
2.4	SANS 780	8.26	Transformer rated no-load secondary voltage	kV	420	_____
2.5	SANS 780	Table 2	Rated short duration power frequency withstand voltage (50Hz)	kVrms	Item specific	_____
2.6	SANS 780	Table 1	Number of phases		3	_____
	SANS 780	6.1.3	Vector group		Dyn11	_____
2.7	SANS 1029	4.1.4.1	System frequency (Hz)		50	_____
2.8	240-56062752	3.1.2.2 d)	Transformer unit with welded cover		Yes	_____
2.9	240-56062752	3.1.2.2 e)	Proposals for the fitting of pressure relieve devices on IRTU fitted Type B mini-sub transformers submitted?		Yes/ NA	_____
2.10			MV system earthing (Effective/Non-effective)		Non-effective	_____
2.11	240-56062752		MV system fault level kA		20	_____
2.12	240-56062752	3.1.2.3 h)	LV transformer neutral earthing		Solid connection to insulated LV neutral/earth bar	_____

2.13	240-56062752	3.7.1	a) Temperature rise limits: Top oil temperature rise	K	55	_____
			b) Temperature rise limits: Average winding temperature rise	K	60	_____
2.14	SANS 780	5.8.2 c)	Tap changer			
			a) Type of Tap		Switch	_____
			b) Secondary voltage regulation (Off-load): Tapping range	%	_5, - 2.5, 0, +2.5, +5	_____
			c) Tap Changer: Manufacturer		xxxxxxxxxx	_____
			d) Model Number		xxxxxxxxxx	_____
			e) Precise electrical location of tapings		xxxxxxxxxx	_____
2.15	SANS 780	5.6.1	No-Load losses	kW	Item specific	_____
2.16	SANS 780	5.6.1	Load losses	kW	Item specific	_____
2.17	SANS 780	8.27	Impedance voltage (see table 9 of SANS 780)	%	Item specific	_____
2.18	240-56062752	3.5 e)	X/R ratio		xxxxxxxxxx	_____
2.19	240-56062752	3.5	Cost /kW od no-load losses	R/kW	xxxxxxxxxx	_____
2.20	240-56062752	3.5	Cost /kW od load losses	R/kW	xxxxxxxxxx	_____
2.21	SANS 780	8.5.3	Audio sound level -Maximum (see table 6 of SANS 780)	dB	Item specific	_____
2.22	SANS 1029	6.4.7	Transformer MV bushings (NB internal screen to be earthed)		EN 50180 Type C with M16X2 thread	_____
2.23	240-56062752	3.2.1.1 a)	a) The transformer bushing-centre spacing shall be	mm	Item specific	_____
2.24	240-56062752	3.2.1.1 b)	b) The distance between the outer bushing-centres and the mini-sub metal enclosure	mm	Item specific	_____
2.25	240-56062752	3.2.1.2	Transformer overload protection facility (LV main circuit breaker)		Yes	_____
2.26	240-56062752	3.2.1.2	Make (product) of circuit breaker		SANS 556-1	_____
2.27	240-56062752	3.2.1.2	Minimum fault current interrupting capacity	kA	xxxxxxxxxx	_____

2.28	SANS 780		a) Transformer winding material (Al/ Cu): MV		xxxxxxxxxx	_____
			b) Transformer winding material (Al/ Cu): LV		xxxxxxxxxx	_____
2.29	240-56062752	3.2.1.2 c)	Top-oil thermoelectric temp-sensing element		xxxxxxxxxx	_____
2.30	240-75661431		Transformer oil type	Must comply with Eskom Standard ESP 32-406	xxxxxxxxx	_____
			Earthing			
3.1	240-56062752	3.1.2.3	LV neutral-earth busbar earthing arrangement		Item specific	_____
3.3	240-56062752	3.1.2.3 c)	LV neutral-earth bar / LV earth bar to be earthed (via a 70mm2 Cu electrical bridge to the mini-sub earth bar)		Yes	_____
3.4	240-56062752	3.1.2.3 d)	i) Neutral surge arrester Class		Class 1	_____
	240-56062752	3.1.2.3 d)	ii) Neutral surge arrester Discharge current rating	kA	10	_____
	240-56062752	3.1.2.3 d)	iii) Neutral surge arrester MCOV	kV	5	_____
	240-56062752	3.1.2.3 d)	iv) Neutral surge arrester Max residual voltage	kV	19.5	_____
	240-56062752	3.1.2.3 d)	v) Neutral surge arrester Min creepage	mm	140	_____
	240-56062752	3.1.2.3 d)	vi) Neutral surge arrester OEM	Name	xxxxxxxxxx	_____
3.5	240-56062752	3.1.2.3	Number of insulated electrolytic copper conductors of cross-sectional area	mm^2	Item specific	_____
3.6	SANS 1029	6.3.3.2.6	a) Clearance to earthed metallic framework	mm	20	_____
			b) Spacing between phase centres shall be	mm	185	_____
			c) The spacing between the lowest (blue) phase busbar and neutral busbar centres shall be	mm	300	_____

			Metering Requirements			
						_____
4.1	SANS 1029	3.1.2.4	Provision of the D-DT-1013 metering requirements		Yes	_____
4.2	240-56062752	3.1.2.4.1	Is the metering voltage secondary circuit as per 240-56062752		Yes	_____
4.3	240-56062752	3.1.2.4.2	Is the metering current secondary circuit as per 240-56062752		Yes	_____
4.4	240-56062752	3.1.2.4.3 a)	Does the metering surge arrester meet the minimum requirements?		Yes	_____
4.5	240-56062752 & SANS 1029	3.1.2.4.3 b)	Does the metering surge arrester meet the following specifications		Yes	_____
	SANS 1029	3.1.2.4.3 b)	i) Imax (8/20 micro s)		40 kA (8/20 micro s) or 65 kA (4/20 micro s)	_____
	SANS 1029	3.1.2.4.3 b)	ii) Response time		< 25ms	_____
	SANS 1029	3.1.2.4.3 b)	iii) Max. operating voltage		275 V a.c. (phase-to-neutral) and 360 V d.c.	_____
	SANS 1029	3.1.2.4.3 b)	iv) Frequency	Hz	50	_____
	240-56062752	3.1.2.4.3 b)	v) Internal fuse		Yes	_____
	240-56062752	3.1.2.4.3 b)	vi) Open-circuit		Open-circuit on expiry of the device	_____
	240-56062752	3.1.2.4.3 b)	vii) Indication		Clear change-of-state (functional or non-functional) indication	_____
4.6	SANS 1029	3.1.2.4.4	Do the LV HRC fuses comply with the requirements of SANS 60269-2?		Yes	_____
4.7	SANS 1029	3.1.2.4.4	Is the LV HRC fuse holder suitable for DIN rail mounting?		Yes	_____
4.8	SANS 1029	3.1.2.4.6	Does the metering wiring circuit meet Eskom's requirements?		Yes	_____

4.9	240-56062752	3.1.2.4.7	Provision of a 22 mm diameter hole fitted with rubber/ plastic cover for the fitment of an external antenna?		Yes	_____
			LV Assembly			
5.1	SANS 1029	6.3.3	Does LV assembly comply with SANS 1973-1?		Yes	_____
5.2	240-56062752	3.1.2.5 c)	Minimum number of outgoing LV cable feeder bays.		Item specific	_____
5.3	240-56062752 & SANS 1029	3.1.2.5 & Fig C.9	Number of gland plates to be provided (see fig C. 9 of SANS 1059)		1 per LV feeder bay	_____
5.4	SANS 1029	6.3.3.3.10	Number of gland holes per LV feeder bay		2	_____
5.5	SANS 1029	6.3.3.3.10	Size of hole per LV feeder bay (diameter)	mm	1 x 65 & 1 x 52	_____
5.7	SANS 1029	6.3.3.3.10	Clearance for each hole per feeder bay	mm	98 (for the 65mm hole) & 65 (for the 52mm hole)	_____
5.8	SANS 1029	6.3.3.3.10	Distance between adjacent feeder bay centre lines (see fig C. 9 of SANS 1059)	mm	110	_____
5.9	240-56062752	3.1.2.5 e)	The LV assembly for mini subs up to and including 500 kVA shall be fitted with an integrated metering infrastructure design.		Item specific	_____
5.10	240-56062752	3.1.2.5 g) & 3.1.2.5 h)	LV feeder protection offered: MCCB or vertical fuse holders?		MCCB or vertical fuse holders?	_____
5.11	240-56062752	3.1.2.6 a)	LV busbar rating (see table 2 of 240-56062752) (A). Rated at 1.2 transformer rated secondary current.	A	Item specific	_____
5.12	SANS 1029	6.3.3.2.6	Clearance between phase to phase centres (see figure C.10).	mm	185 (min)	_____
5.13	SANS 1029	6.3.3.2.6	Clearance between the lowest (blue) phase busbar and neutral busbar centres (see figure C.10).	mm	300 (min)	_____
5.14	SANS 1029	6.3.3.2.6	Clearance between lowest LV neutral and gland plates (see figure C.10)	mm	200 (min)	_____
5.15	240-56062752	3.1.2.6	a) Busbar insulation		Air insulated	_____

			b) Busbars		3 + one identical neutral-earth busbar (insulated from frame)	_____
5.16	SANS 1029 & SANS 1973-1	6.3.3.1	Does current density of busbars meet Eskom's requirements?	A/mm2	Yes	_____
5.17	SANS 1029 & SANS 1973-1	4.1.2.5	Does the rated short-time withstand current of main circuit (1 s) meet Eskom's requirements?	kArms	xxxxxxxx	_____
5.18	240-56062752	3.1.2.6 b)	Stainless Steel M12 set screws provided		Yes	_____
			LV Auxiliary equipment			
6.1	240-56062752	3.1.2.8 a)	LV maximum demand ammeters to be provided for all three phases		Yes	_____
6.2	SANS 1029	6.3.3.5.1	Ammeter type		Thermal integrating over 15 min period	_____
6.3	240-56062752	3.1.2.8 a)	Additional electronic type ammeters provided for IRTU fitted mini subs		Item specific	_____
6.4	240-56062752	3.1.2.8 b)	One voltmeter with a selector switch provided?		Yes	_____
6.5	240-56062752	3.1.2.8 b)	Additional electronic type voltmeter provided for IRTU fitted mini subs		Item specific	_____
6.6	SANS 1029	6.3.3.5.3	Ammeter and voltmeter size and display (mm)		96 X 96	_____
6.7	SANS 1029	6.3.3.5.3	Ammeter and voltmeter position		LV compartment (as high as possible)	_____
6.8	240-56062752	3.1.2.8 c)	Provision for three point socket outlet in LV compartment (with instantaneous-trip earth leakage unit [20 A, 5 kA rapturing capacity, 30 mA sensitivity] and 20 A HRC fuse with neutral fuse link		Yes	_____
6.9	240-56062752	3.1.2.8 d)	Provision of tamperproof compartment for the installation of a photocell.		Yes	_____
6.10	240-56062752	3.1.2.8 d)	300 mm X 300 mm blank plate for PECU		Yes	_____
6.11	240-56062752	3.1.2.8 d)	Numbering of ferrules for auxiliary wiring		Yes	_____

			General Electrical Requirements			
7.1	240-56062752	3.1.2.9 a)	Is the wiring of the mini sub as per D-DT -0868		Yes	_____
7.2	240-56062752	3.1.2.9 b)	Do LV auxiliary fuses comply with the requirements of fuse system G in accordance with SANS 60269-2		Yes	_____
7.3	240-56062752	3.1.2.9 b)	LV auxiliary fuses shall be of size E1.		Yes	_____
7.4	240-56062752	3.1.2.9 d)	Are terminal blocks in accordance with DSP 34-253?		Yes	_____
7.5	240-56062752	3.1.2.9 d)	Do terminal blocks have spring loaded screw terminals?		Yes	_____
			Type A Specific Requirements			
8.1	240-56062752	3.2 a)	a) MV compartment that is fitted with an off-load, dead-break isolating arrangement		Item specific	_____
			b) MV compartment, that consists of extensible screened separable connectors at 11 kV and 22 kV (see fig 4 and fig 5)		Item specific	_____
			c) Make (product) of connector used on transformer bushing		Item specific	_____
8.2	240-56062752	3.2.2.1 b)	a) Provision for the support (clamping) of two incoming cables in the MV compartment (see D-DT-8019 & SANS 876).		Item specific	_____
			b) The distance from the cable support point (clamp) to the transformer bushing centres.	mm	Item specific	_____
			c) The cable support clamps shall be range taking	mm	Item specific	_____
8.3	240-56062752	3.2.2.1 e)	The internal width of the MV compartment.	mm	Item specific	_____
8.4	240-56062752	3.2.2.1 f)	The height of the MV compartment door opening above the horizontal bushing centre-line.	mm	Item specific	_____

9			**Type B Specific Requirements**			
9.1	240-56062752 & 240-97690165	3.3 a)	a) Medium voltage compartment shall be fitted with a non-extensible 2R-1B RMU.		Item specific	_____
			b) Medium voltage compartment shall be fitted with a non-extensible 2R-1B RMU and IRTU.		Item specific	_____
9.2			RMU manufacturer	Name	xxxxxxxxxx	_____
9.3	240-56062752	3.3.1.1 b)	a) Integral cable test facilities that do not require access to the cable termination enclosure.		Item specific	_____
			b) Cable test facility with interlocking capability		Item specific	_____
			c) Working instructions for the RMU for the correct reinstatement procedure of the earth connection on the cable test facilities.		Item specific	_____
9.4	240-56062752	3.3.1.1 c)	Remote tripping (hand-held push-button remote control unit) provided		Item specific	_____
9.5	240-56062752	3.3.1.1 d)	a) RMU incoming/ outgoing MV cable requirement:		3 core	_____
		3.3.1.1 c) vi	b) Cable support (clamping) required SANS 876 and D-DT 8019 all three core cables. Outer diameter (mm)	mm	Item specific	_____
			c) Cable support (clamping) required SANS 876 and D-DT 8019 all single core cables. Outer diameter (mm)	mm	Item specific	_____
9.6	240-56062752	3.3.1.1 d) iv)	a) For 11 kV RMUs: Where unscreened separable connectors are used for the tee-off circuit-breaker, the minimum spacing between bushing centres. (mm)	mm	Item specific	_____
			b) For 11 kV RMUs: Where screened separable connectors are used for the tee-off circuit-breaker, the minimum spacing between bushing centres. (mm)	mm	Item specific	_____
		3.3.1.1 d) iv)	c) For 11 kV RMUs: Where unscreened separable connectors are used for the tee-off circuit-breaker, the minimum spacing between the outer bushing centres and earthed metal enclosure shall be 55 mm respectively.	mm	Item specific	_____

			d) For 11 kV RMUs: Where screened separable connectors are used for the tee-off circuit-breaker, the minimum spacing between the outer bushing centres and earthed metal enclosure shall be 55 mm respectively.	mm	Item specific	_____
		3.3.1.1 d) ii)	e) The cable termination enclosure for 3-core cable terminations shall have a 800 mm minimum bushing centre line spacing distance to the bottom cable entry or bottom entry plate.	mm	Item specific	_____
9.7	240-56062752	3.3.1.1 e)	Is an "integrated" voltage detection system (VDS) with fixed voltage indicators and test points provided?		Item specific	_____
		3.3.1.2 a)	Type (make and product) for interconnection cable (SANS 1029) offered? SANS 1339 or IEC 60502-2.	SANS 1339 or IEC 60502-4	xxxxxxxxxx	_____
9.8	240-56062752 SANS 1332 and D-DT 8017	3.3.1.2 a) and b)	a) Type of connection (SANS 1332) to RMU		Item specific	_____
			b) Make (product) connector used on transformer bushing (SSC)		xxxxxxxxxx	_____
			c) Make (product) connector used on RMU T-Off (SSC)		xxxxxxxxxx	_____
9.9	240-56062752	3.3.1.2 c)	Interconnection arrangement between RMU and transformer MV bushings.		Item specific	_____
9.10	240-56062752	3.3.1.3	a) The transformer bushing-centre spacing. (mm)	mm	Item specific	_____
			b) The distance between the outer bushing centres and the mini-sub metal enclosure. (mm)	mm	Item specific	_____
9.11	240-56062752	3.3.1.4	a) The transformer unit shall be fitted with a top-oil thermoelectric temperature-sensing element		Item specific	_____
			b) For IRTU fitted mini subs: A proposal for digital gauges for temperature sensing element for the transformers submitted?		Item specific	_____
9.12	240-56062752	3.3.1.5 a)	a) For mini subs up to 500 kVA: Main LV switch dis-connector provided?		Item specific	_____
			b) The type (product make) of switch dis-connector offered?		Item specific	_____

9.13	240-56062752	3.3.1.5 b)	a) For mini subs up to 1000 kVA: Main LV circuit breaker provided?		Item specific	_____
			b) The type (product make) of circuit breaker offered?		xxxxxxxxxx	_____
9.14	240-56062752 Table 4	3.3.1.5 c)	The standard size of switch dis-connector or circuit breaker offered:		Item specific	_____
9.15	240-56062752	3.3.1.6	a) For IRTU fitted mini subs: Does the IRTU meet Eskom's requirements?		Item specific	_____
			b) All drawings, technical schedules and type test reports in accordance with 240-97690165 and SANS 1874 to be submitted?		Item specific	_____
9.16	240-56062752	3.3.2 a)	For mini-subs designed for the fitting of LV circuit breakers: does the mini sub meet the following requirements?			_____
			a) The LV assembly shall be at least 1000 mm		Item specific	_____
			b) Does the LV assembly accommodate a minimum of 6 LV circuit?		Item specific	_____
			c) Are LV circuit breakers up to 150 mm wide?		Item specific	_____
			d) Is the clearance between the LV circuit breakers 20 mm between circuit breakers?		Item specific	_____
9.17	240-56062752	3.3.2 b)	Is LV busbars and gland plate support structure pre-drilled to allow for up to 9 feeder bay, and are six gland plates provided?		Yes	_____
9.18	240-56062752	3.3.2 c)	Does the mini-sub base have four 24 mm Ø round mounting holes?		Yes	_____
9.19	240-56062752	3.3.3	Does the protection relay meet Eskom's minimum requirements?		Item specific	_____
9.20	240-56062752 & SANS 1029	3.7.2	a) Does internal arc classification test for Type B mini-subs meet Eskom's requirements?		Item specific	_____
		3.7.2 a)	b) Are all type test performed on the enclosure offered?		Item specific	_____
		3.7.2 b)	c) Are all type tests performed on each RMU offered? (test for each RMU supplier type if not using one supplier)		Item specific	_____

		3.7.2 c)	d) Are all RMU compartments tested in according to SANS 62271-200 for both the IAC-A and IAC-B tests of the mini-sub enclosure?		Item specific	_____
		3.7.2 d)	e) Are all applicable type test videos for all applicable IAC AB test supplied?		Item specific	_____
10			**Additional general requirements for 1000 kVA mini subs**			
10.1	240-56062752	3.4.1 a)	Is mini sub suitable for the standard size as per the following clauses:			_____
			a) 1 MVA Type B: suitable for type B mini substandard size		Item specific	_____
			b) 1 MVA Type A: suitable for a special 1 MVA Type A plinth as per D-DT 0859		Item specific	_____
10.2	240-56062752	3.4.1 b)	Eskom Compartment			_____
			a) Is the LV compartment divided into 3 sub compartments (i.e Eskom panel, Metering and control panel, and customer panel)?		Item specific	_____
		3.4.1 c)	b) Does each LV sub compartment have its individual door that is lockable?		Item specific	_____
10.3	240-56062752	3.4.2.2	Are the following equipment fitted in the Eskom panel:			_____
		3.4.2.2 a)	a) 16 A three pin socket outlet and protection equipment?		Item specific	_____
		3.4.2.2 b)	b) LV ammeters?		Item specific	_____
		3.4.2.2 c)	c) LV voltmeter and selector switch?		Item specific	_____
		3.4.2.2 d)	d) Earth fault indicator?		Item specific	_____
		3.4.2.2 e)	e) Transformer over load protection?		Item specific	_____
10.4			**Metering and Control panel**			
10.4.1	240-56062752	3.4.2.3 a)	Is a 1600 A main LV circuit breaker provided?		Item specific	_____
10.5			**Customer Panel**			

10.5.1	240-56062752	3.4.2.4 a)	a) Do the LV busbars, earth bars and gland plate arrangement meet Eskom's specification?		Item specific	_____
			b) The panel should be designed to be used with either: Vertical fuse bases or large frame MCCBs		Vertical fuse bases or Large frame MCCBs	_____
10.5.2	240-56062752	3.4.3	Does the LV main circuit breaker protection relay settings comply with Eskom's requirements?		Yes	_____
10.5.3	240-56062752	3.4.4	Does the MCCB mounting plate meet the following requirements:			_____
			a) Aperture	mm	Item specific	_____
			b) Pitch of aperture	mm	Item specific	_____
			c) Thickness of material	mm	Item specific	_____
			d) Minimum perforated area for Type B, L X W	mm x mm	Item specific	_____
			e) Minimum perforated area for Type A, L X W	mm x mm	Item specific	_____
11			**Construction Requirements**			
11.1	240-56062752	3.1.3.1.d)	Does the base channel and sills of the doors comply		Yes	_____
11.2	240-56062752	3.1.3.1.e)	Does the three-point locking mechanism on each compartment door have an additional, captive, 10 mm Allen cap screw?		Yes	_____
11.3	240-56062752	3.1.3.1.f)	Are all door handles manufactured from stainless steel and classified as heavy duty?		Yes	_____
11.4	240-56062752	3.1.3.1.g)	Is a pad lock protection provided?		Yes	_____
11.5	240-56062752	3.1.3.1.j)	a) For IRTU fitted mini subs: Is a proposal for additional fitting of remote controlled door locking devices provided?		Item specific	_____
		3.1.3.1.k)	b) For Type B mini subs: Proposal for alternative mechanical door locking devices and padlock protection facilities provided?		xxxxxxxxxx	_____
12			**Materials and Corrosion Protection**			

12.2	240-56062752 & SANS 60815-1	3.1.3.2 c)	For mini-subs classified as “coastal”, the class of pollution characterising the site severity shall be “e” (i.e. “very heavy”)		Item specific	_____
12.5	240-56062752	3.1.3.2 e)	the mini-sub enclosure, LV ASSEMBLY steelwork and transformer tank shall be: 3CR12 or stainless steel		Item specific	_____
12.6	240-56062752 & 240-75655504	3.1.3.2 j) & 3.9.2	Corrosion protection offered for Coastal application		Item specific	_____
12.8	240-56062752	3.1.3.2 j)	The transformer-cooling radiator shall be:		Item specific	_____
12.10	240-56062752 & 240-75655504	3.1.3.2 j) 3.9.2	Corrosion protection for transformer radiator		Item specific	_____
12.11	240-56062752	3.1.3.2 g)	The mini-sub base shall be hot-dipped galvanized mild steel and shall be finished with a black coating		Yes	_____
12.12	240-56062752	3.1.3.2 h)	The gland plate support structure and gland plates shall be stainless steel.		Yes	_____
12.13	240-56062752	3.1.3.2 k)	Is a 5 mm thick cork packing (i.e. cork gasket) applied in all the necessary arears?		Yes	_____
12.14	240-56062752 & SANS 1091	3.1.3.2 l)	Is the colour of the mini sub Avocado (C12)?		Yes	_____
13			**Additional requirements for “high-risk” mini-subs**			
13.1	240-56062752	3.1.3.3 a)	All mini-sub doors (MV and LV) shall be recessed such that they are flush with the sides of the mini-sub enclosure.		Item specific	_____
13.2	240-56062752	3.1.3.3 b)	The mini-sub enclosure, doors and lock protection facilities shall be manufactured using 6 mm thick steel.		Item specific	_____
13.3	240-56062752	3.1.3.3 c)	The doors shall be re-enforced using additional steel strength members diagonally welded from corner to corner on the inside surface of the door.		Item specific	_____
13.4	240-56062752	3.1.3.3 d)	Heavy duty hinges shall be fitted for the doors.		Item specific	_____

13.5	240-56062752	3.1.3.3 e)	A four-point locking mechanism (i.e. at the top-centre, bottom-centre, left-centre and right-centre) using bars operated by a heavy duty door handle shall be fitted.		Item specific	_____
13.6	240-56062752	3.1.3.3 f)	IRTU fitted mini-subs: is a proposal for electrical locking mechanisms and door alarm sensors provided?		Item specific	_____
14			**Marking, labelling, packaging and transport**			
14.1	240-56062752	3.8.1.1	Does the mini-sub rating plate meet Eskom's requirements?		Yes	_____
14.2	240-56062752	3.8.1.2 a)	Is treatment and Full First Aid Instructions in accordance with D-DT-6073 “SIGN D, E submitted?)		Yes	_____
14.3	240-56062752	3.8.1.2 b)	Are the MV and warning signs in accordance with D-DT 3202 submitted?		Yes	_____
14.4	SANS 1029	8.4.11	Are transformer phase label provided below the bushings?		Yes	_____
14.5	SANS 1029	6.3.3.2.5	Colour coded LV bus bar provided?		Yes	_____
14.6	240-56062752	3.8.1.3 a)	Primary voltage, secondary voltage and kVA rating stencilled on the front centre?		Yes	_____
14.7	SANS 1029	8.4.4	Mini sub mass and stock number stencilled on the side or rear?		Yes	_____
14.8	SANS 1029	4.2.2.3.9	Provision for the safe keeping of documents?		Yes	_____
14.9	240-56062752	3.8.1.3 e) i & ii	For Type B units: Short operating procedure written in black text on orange background provided?		Item specific	_____
14.1	240-56062752	3.8.1.3 e) iii	Is a drawing depicting the wording of the operating procedure provided?		Yes	_____
15			**Documentation**			
15.1	240-56062752	3.8.2.3	Type test report and certificates provided?		Yes	_____
15.2	240-56062752	3.8.2.3	Are routine test certificates submitted?		Yes	_____
15.3	240-56062752	3.8.2.2 a)	Are the following drawing submitted?		Yes	_____
			a) Mini sub GA drawing		Yes	_____

			b) LV assembly drawing		Yes	_____
			c) Operating procedure label for RMU tee off		Item specific	_____
			d) For Type B mini subs: Relay settings drawing		Item specific	_____
			e) Mini sub schematic drawing		Yes	_____
			f) Wiring diagram		Yes	_____
			g) Rating plate drawing		Yes	_____
		3.8.2.2 b)	h) For Type B mini sub: drawing for the operating procedure label for the RMU		Item specific	_____
16			**Accessories**			
16.1	240-56062752	3.10 a)	Hand-held push-button remote control unit with a portable power supply is to be supplied with the ring main unit?		Item specific	_____
16.2	240-56062752	3.10 b)	Type of sealant provided?		Poly-urethane or equivalent	_____
16.3	240-56062752	3.10 c)	Holding down set screws supplied?		Yes	_____
SIGNATURES						
Supplier			Name (Print)		Sign	Date
Factory			Name (Print)		Sign	Date
Eskom			Name (Print)		Sign	Date

Annex E – Technical Schedules A and B For: 11 kV or 22 kV Mini-sub RMU, 11 kV or 22 kV IRTU Fitted Mini-sub RMU

	TECHNICAL SCHEDULES A & B FOR 240-56030406				
	MINI-SUB RING MAIN UNITS FOR SYSTEMS WITH NOMINAL VOLTAGES FROM 11 KV TO 33 KV				
	SHORT DESCRIPTION: RMU 11kV 630A200A 2R1B N/E CST I/D D8060				
	Schedule A: Purchasers specific requirements				
	Schedule B: Guarantees and technical particulars of equipment offered				
	2	3		4	5
	Sub-clause	**Description**		**Schedule A**	**Schedule B**
	Item Description	**RMU 11kV 630A200A 2R1B N/E CST I/D D8060**			
1		**Ratings**			
1.1		Nominal voltage	kV_{rms}	11 or 22	_____
1.2	SANS 1874 4.2.1	Rated power-frequency voltage	kV_{rms}	12 or 24	_____
1.3	SANS 1874 4.2.2	System frequency	Hz	50	_____
1.4		Number of phases		3	_____
1.5		System voltage range	pu	0.9 to 1.1	_____
1.6	240-56062752 3.1.2.1 &	Rated lightning impulse withstand voltage	kV_{peak}	95 or 125	_____

	SANS 1874 4.2.3				
1.7	SANS 1874 4.2.3	Rated short-duration power frequency withstand voltage [50Hz: 1 min]	kV_{rms}	28 or 50	_____
1.8	SANS 1874 4.7.1	Rated normal current of busbars	A	630	_____
1.9	SANS 1874 4.4.1.3	Rated normal current of switch disconnector	A	630	_____
1.10	SANS 1874 4.6.1.3	Rated current of circuit breaker	A	630 or 200	_____
1.11	SANS 1874 4.2.4.1	Rated short-time withstand r.m.s. current (3 seconds)	kA_{rms}	20 or 16	_____
1.12	SANS 1874 4.2.4.3	Rated short-time withstand r.m.s. current (3 seconds) of earthing switches	kA_{rms}	20 or 16	_____
1.13	SANS 1874 4.2.4.1	Rated peak withstand current	kA_{peak}	50 or 40	_____
1.14	SANS 1874 4.2.6	Rated short circuit breaking current of the circuit breaker	kA_{rms}	20 or 16	_____
1.15	SANS 1874 4.2.7	Rated short circuit making current	kA_{peak}	50 or 40	_____
2		**Design**			
2.1	240-56062752 3.3.1.1 & 3.3.1.2	Miniature substation mounting	M/S	Mini sub fitting	xxxxxxxx
2.2	SANS 1874 4.18	The RMU to be fitted in the Mini-substation enclosure shall be suitable for coastal applications		All RMUs shall be suitable for Coastal applications	xxxxxxxx
2.3	SANS 1874 4.3.2	Extensible unit required?		No	xxxxxxxx
2.4	SANS 1874 4.3.3.3	Degree of protection offered (RMU):			

	SANS 62271-200	a) moving parts		IP 2X	_____
	SANS 62271-200	b) live parts		IP 2X	_____
	SANS 876	c) cable boxes		IP 3X	_____
2.5	240-56062752 3.3 a)	Configuration		2R-1B	xxxxxxxx
2.6	240-56062752 3.3.1.1 a) & SANS 1874 4.3.5	Type of cable test facilities offered?		Yes	xxxxxxxx
	SANS 1874 4.3.5.4	Cable test facilities interlocked?		Yes	xxxxxxxx
2.7	SANS 1874 4.3.9.1	Interlock with remote equipment required? If yes, state details:	Y/N	No	_____
		a) type of interlock required		N/A	_____
		b) auxiliary supply details		20 or 16	_____
		c) interfacing details of remote equipment		N/A	_____
2.8	SANS 1874 4.3.9.2	Interlocking facilities offered		N/A	xxxxxxxx
2.9	SANS 1874 4.3.10.2	Insulating medium		xxxxxxxx	_____
2.10	SANS 1874 4.3.10.2	Minimum maintenance free period	yrs	30	_____
2.11	SANS 1874 4.3.10.3	Interrupting technology (switch dis-connectors)		xxxxxxxx	_____
2.12	SANS 1874 4.3.10.3	Interrupting technology (circuit breaker)		xxxxxxxx	_____
2.13	SANS 1874 4.3.14.1 a)	IAC required for RMUs -AFLR in accordance with SANS 62271-200?		Yes	xxxxxxxx

2.14	SANS 1874 4.3.14.1 b) & 240-56062752 3.7.2	IAC required for the RMUs fitted in Mini-subs (AB - FLR in accordance with SANS 62271-200 & SANS 62271-202)?		Yes	xxxxxxxx
3	SANS 1874 4.4	**Switch-disconnectors**			
3.1	SANS 1874 4.4.1.1	Class of switch dis-connector (min)		E2-M1	_____
3.2	SANS 1874 4.3.5.1 & 240-56062752 .3.1.1 a)	Cable test facility to be independent of cable termination enclosure?		Yes	_____
3.3	SANS 1874 4.3.5.4	Cable test facilities interlocked?		Yes	
3.4	SANS 1874 4.4.2.2 / 4.9.2	Provision for remote tripping and closing required (i.e. remote control via RTU)?		N/A	xxxxxxxx
3.5	SANS 1874 4.4.2.2 / 4.9.2	Details of remote opening and closing offered		N/A	xxxxxxxx
3.6	SANS 1874 4.4.2.2 / 4.9.2	Provision for remote indications and alarms required (i.e. via RTU)?		N/A	xxxxxxxx
3.7	240-56062752 3.3.1.1 b)	Provision for hand-held remote control unit (open, close and earth) required?		Yes	_____
3.8	240-56062752 3.3.1.1 b)	Type of plug-in connector to be supplied		ITT Cannon type CA 3102 A 14S-2 or equivalent	_____
3.9	240-56062752 3.3.1.1 b)	Pins for trip control function		C and D	_____
3.10	240-56062752 3.3.1.1 b)	Pins for close control function		A and B	_____
3.11	240-56062752 3.3.1.1 b)	Details of provisions offered for hand-held remote control unit	24V/110V	Yes	_____
3.12	SANS 1874 4.9.1.1	Load monitoring (metering) facility required?	Y/N	No	_____
3.13	SANS 1874 4.9.1.4	Accuracy class and burden (VA) of CT offered (if applicable)		N/A	xxxxxxxx

3.14	SANS 1874 4.9.1.6 / 4.9.2	Provision for communication with an RTU (i.e. remote analogue indication)?		No	xxxxxxxx
3.15	SANS 1874 4.9.1.7	Type of electronic ammeter/multi-meter offered		xxxxxxxx	_____
4	SANS 1874 4.8	**Cable termination enclosure of the switch dis-connector functional units**			
4.1	240-56062752 3.3.1.1 c)	Spacing between bushing centres (min)	mm	105	_____
4.2	240-56062752 3.3.1.1 c)	Spacing between outer bushing centres and enclosure side wall (min)	mm	55	_____
4.3	SANS 1874 4.8	Distance from bushing centre line to cable support clamp (min). The cable support clamp shall be mounted above any bottom enclosure mounted plates for 3 core cable termination applications. For 1 core cable termination applications where bottom plates are required to be mounted above the cable clamps for Internal Arc venting compliance, the plate shall be positioned to meet the SANS 876 requirement for a 22 kV voltage rating single core cable termination to be fitted.	mm	800	_____
4.4	SANS 1874 4.8	Bushings horizontally positioned?	Y/N	YES	_____
4.5	SANS 1874 4.8.4	Type of bushing		EN 50181 C-type interface	_____
4.6	SANS 1874 4.11.4	Cross sectional area of earthing bar (min)	mm^2	120	_____
4.7	SANS 1874 4.8.6	Type of cable support clamp		SANS 876 /	
				D-DT-8019 / 240-56062752	_____
4.8	240-56062752 3.3.1.1 c)	Size (range) of cable support clamp (3 Core Cable applications)	mm	50-100	_____

4.9	240-56062752 3.3.1.1 c)	Size (range) of cable support clamps (3 * 1 Core Cable applications)	mm	25-55	_____
5	SANS 1874 4.6	**Circuit-breakers for tee-offs**			
5.1	SANS 1874 4.6.1.1	Class of circuit-breaker (min)		E2-M1	_____
5.2	SANS 1874 4.6.1.3	Rated normal current of the circuit-breaker (200A/630A).	A	200A / 630A	_____
5.3	SANS 1874 4.3.5.1 & 240-56062752 .3.1.1 a)	Cable test facility to be independent of cable termination enclosure?	Y/N	Not mandatory (if available to be supplied)	_____
5.4	SANS 1874 4.6.3.3 / 4.9.2	Provision for remote tripping and closing, and the opening for the inline dis-connector required (i.e. remote control via RTU)?	Y/N	No	xxxxxxxx
5.5	SANS 1874 4.6.3.4	Details of remote tripping and closing, and the opening for the inline dis-connector where applicable offered.		xxxxxxxx	_____
5.6	SANS 1874 4.9.2	Provision for remote indications and alarms required (i.e. via RTU)?	Y/N	No	xxxxxxxx
5.7	240-56062752 3.3.1.1 b)	Provision for hand-held remote control unit (trip and close) required?	Y/N	Yes	_____
5.8	240-56062752 3.3.1.1 b)	Type of plug-in connector to be supplied		ITT Cannon type CA 3102 A 14S-2 or equivalent	_____
5.9	240-56062752 3.3.1.1 b)	Pins for trip control function		C and D	_____
5.1	240-56062752 3.3.1.1 b)	Pins for close control function		A and B	_____
5.11	240-56062752 3.3.1.1 b)	Details of provisions offered for hand-held remote control unit	24V/110V	xxxxxxxx	_____
5.12	SANS 1874 4.9.1.1	Load monitoring (metering) facility required?	Y/N	No	_____

5.13	SANS 1874 4.9.1.4	Accuracy class and burden (VA) of CT offered		xxxxxxxx	_____
5.14	SANS 1874 4.9.1.6 / 4.9.2	Provision for communication with an RTU (i.e. remote analogue indication)?	Y/N	No	xxxxxxxx
5.15	SANS 1874 4.9.1.7	Type of electronic ammeter/multi-meter offered		xxxxxxxx	_____
	240-56062752 3.3.1.1 e), 3.3.3 & Annex A	**Protection relay**			
5.16	240-56062752 4.1.2.4	CT ratio required if different to that specified in 4.1.2.4	A	As per minisub spec	_____
5.16.1	240-56062752 3.3.1.1 e), 3.3.3 & Annex A	Protection CT type and class		xxxxxxxx	_____
5.16.2	240-56062752 3.3.1.1 e), 3.3.3 & Annex A	Details of provisions made to ensure minimum earth fault pick-up current of 40 A or 50 A.		xxxxxxxx	_____
5.163	240-56062752 3.3.1.1 e), 3.3.3 & Annex A	Setting ranges and protection element curves (provide technical manual).		xxxxxxxx	_____
6	SANS 1874 4.8	**Cable termination enclosure of the circuit breaker functional units**			
6.1	240-56062752 3.3.1.1 c)	Spacing between bushing centres (min)	mm	90	_____
6.2	240-56062752 3.3.1.1 c)	Spacing between outer bushing centres and enclosure side wall (min)	mm	55	_____
6.3	SANS 1874 4.8	Distance from bushing centre line to cable support clamp (min).	mm	800	_____
6.4	SANS 1874 4.8	Bushings horizontally positioned?	Y/N	YES	_____
6.5	SANS 1874 4.8.4	Type of bushing		EN 50181 C-type	_____

				interface	
6.6	SANS 1874 4.11.4	Cross sectional area of earthing bar (min)	mm^2	120	_____
6.7	SANS 1874 4.8.6	Type of cable support clamp		SANS 876 /	
				D-DT-8019	_____
6.8	240-56062752 3.3.1.1 c)	Size (range) of cable support clamp (3 Core Cable applications)	mm	50-100	**N/A**
6.9	240-56062752 3.3.1.1 c)	Size (range) of cable support clamps (3 * 1 Core Cable applications)		Xxxxxxxx	_____
		General			
7	SANS 1874 4.7	**Busbars**			
7.1	SANS 1874 4.7.2	Current rating of busbars	A	630	_____
7.2	SANS 1874 4.7.2	Busbars to be extensible left or right?	L / R /NA	N/A	xxxxxxxx
7.3	SANS 1874 4.7.3	Method of extending busbars		Xxxxxxxx	xxxxxxxx
7.4	SANS 1874 4.7.5	Extensible busbar insulating medium		Xxxxxxxx	_____
8	SANS 1874 4.9	**Telecontrol**			
8.1	240-56062752 3.3 a)	RTU to be provided?	Y/N	No	xxxxxxxx
8.2	SANS 1874 4.9.2	Provision for remote status indications and alarms required?	Y/N	No	xxxxxxxx
8.3	SANS 1874 4.9.2	Local indications to be provided?	Y/N	N/A	xxxxxxxx
8.4	SANS 1874 4.9.2	d.c. voltage required?	110V/24V	N/A	xxxxxxxx

8.5	SANS 1874 4.9.2	Details of auxiliary supply for RTU provided?	Y/N	N/A	xxxxxxxx
8.6	240-56062752 3.3 a)	LV auxiliary supply to be provided from the mini-sub transformer	Y/N	N/A	xxxxxxxx
9	SANS 1874 4.10	**Gas requirements**			
9.1	SANS 1874 4.10.2	Expected life before replenishment of gas (minimum)	Years	30	_____
9.2	SANS 1874 4.10.3 & 240-56062752 3.3.1.1 f)	Type of gas indication device		Density meter	_____
9.3	SANS 1874 4.10.5	Mass of gas:			_____
		a) Busbar chamber	kg	Xxxxxxxx	_____
		b) Other	kg	Xxxxxxxx	_____
9.4	SANS 1874 4.10.6	Service offered for replenishment and recovery of gas		Xxxxxxxx	_____
	SANS 1874 4.11	**Earthing**			_____
9.5	SANS 1874 4.11.1	Earth fault level and duration	kA-s	2 kA – 3 s	_____
	SANS 1874 4.12	Live circuit indication			_____
9.6	SANS 1874 4.12.4 & 240-56062752 3.3.1.1 d)	Type of live circuit indication required		VDS	_____
10	SANS 1874 4.13	**Earth fault indication**			
10.1	SANS 1874 4.13.1	Type of earth fault indicator		Powered via Transformer	_____
		Earth fault indicator details:			_____
10.2	SANS 1874 4.13.6	a) Cable box location for CT		LHS ‘R’	_____

10.3	SANS 1874 4.13.7	b) Position of 'remote' indicator		Visible from outside, front of Mini-sub	_____
10.4	SANS 1874 4.13.7	c) Method of protecting indicator against vandalism		Welded steel tube	_____
10.5	SANS 1874 4.13	Make of earth fault indicator		Xxxxxxxx	_____
10.6	SANS 1874 4.13	Type (model) of earth fault indicator		Xxxxxxxx	_____
11	SANS 1874 4.16	**Accessories**			_____
11.1	SANS 1874 4.16.4	Description of tool set required		Xxxxxxxx	_____
11.2	240-56062752 3.3.1.1 b)	Hand-held push-button remote control unit with a portable power supply to be supplied with the RMU?	Y/N	Yes	_____
11.3	240-56062752 3.3.1.1 b)	Type of plug-in connector to be supplied		ITT Cannon type CA 3102 A 14S-2 or equivalent	_____
11.4	240-56062752 3.3.1.1 b)	Pins for trip control function		C and D	_____
11.5	240-56062752 3.3.1.1 b)	Pins for close control function		A and B	_____
11.6	240-56062752 3.3.1.1 b)	Length of umbilical cord to be supplied	m	20	_____
11.7	240-56062752 3.3.1.1 b)	Details of portable power supply		24 V	_____
12	SANS 1874 4.17	**Rating plate**			_____
12.1	SANS 1874 4.17.1	Method of attaching rating plate		Xxxxxxxx	_____
13	SANS 1874 4.18	**Marking and labelling**			
13.1	SANS 1874 4.18.1.1	Method of attaching labels		Xxxxxxxx	_____

13.2	SANS 1874 4.18.2.1	Method of fixing and removal of main circuit designation labels for engraving purposes		Xxxxxxxx	_____
13.3	SANS 1874 4.18.4.4	Mimic indication system required?	Y/N	Yes	xxxxxxxx
13.4	SANS 1874 4.18.4.4	Description of mimic indication system		Xxxxxxxx	_____
14	SANS 1874 4.18 & 240-56062752 3.1.3.2	**Corrosion protection**			
14.1	SANS 1874 4.18 & 240-56062752 3.1.3.2	Application with regard to corrosion protection		Coastal	_____
14.2	SANS 1874 4.18.9	Type of material offered:			
		a) Ring main unit gas enclosure		Xxxxxxxx	_____
		b) Cable termination enclosures and frame		Xxxxxxxx	_____
		c) Operating mechanisms		Xxxxxxxx	_____
14		**Testing**			
15.1	SANS 1874 5.1.3	Origin of RMU design		Xxxxxxxx	_____
		Origin of Vacuum Interrupter design		Xxxxxxxx	_____
		Origin of CT design		Xxxxxxxx	_____
		Origin of IRTU design		Item specific	_____
15.2	SANS 1874 5.1.3	Place of RMU manufacturer		Xxxxxxxx	_____
		Place of Vacuum Interrupter manufacturer		Xxxxxxxx	_____

		Place of CT manufacturer		Xxxxxxxx	_____
		Place of IRTU manufacturer		Item specific	_____
15.3	SANS 1874 5.1.3	Number of RMU units supplied in South Africa		Xxxxxxxx	_____
15.4	SANS 1874 5.2.3	RMU Internal arc type test details		Xxxxxxxx	_____
15.5	SANS 1874 5.2	RMU type test reports		Yes	xxxxxxxx
15.6	240-56062752 3.7.2	Mini-sub and RMU type test reports and videos		Yes	xxxxxxxx
15.7	240-97690165	IRTU type test and test reports		Item specific	xxxxxxxx
16		**Spares**			_____
16.1	SANS 1874 6.1	List of recommended spares		Xxxxxxxx	_____
17	SANS 1874 7.2	**Documentation**			
17.1	SANS 1874 7.2	Drawing numbers submitted:		Xxxxxxxx	_____
17.2	SANS 1874 7.2	General assembly drawing(s)		Xxxxxxxx	_____
17.3	SANS 1874 7.2	Drawing(s) showing mimic indication system, tee-off operating procedure, other labels & signs		Xxxxxxxx	_____
17.4	SANS 1874 7.2	Wiring diagram(s)		Xxxxxxxx	_____
17.5	SANS 1874 7.2	Rating plate drawing		Xxxxxxxx	_____
17.6	SANS 1874 7.2	Tabulated summary of completed type tests required?	Y/N	Yes	_____
17.7	SANS 1874 7.2	Full set of type test reports required?	Y/N	Yes	_____

17.8	SANS 1874 7.2	Proof of type test laboratory accreditation?	Y/N	Yes	_____
17.9	SANS 1874 7.2	Copy of RMU factory routine test certificate?	Y/N	Yes	_____
17.1	SANS 1874 7.2	Copy of CT factory routine test certificate?	Y/N	Yes	_____
17.11	SANS 1874 7.2	Copies of the latest technical catalogue(s) including protection relay and/or electronic ammeter/multi-meter technical manual (if applicable)?	Y/N	Yes	_____
17.12	SANS 1874 7.2	Number of installation, operation and maintenance manuals to be provided with the tender		1	_____

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