| Eskom | Standard | Technology |
|---|---|---|

Title: **SPECIFICATION FOR RING MAIN UNITS FOR SYSTEMS WITH NOMINAL VOLTAGES FROM 3.3 KV TO 33 KV**

| | |
|---|---|
| Unique Identifier: | **240-56030406** |
| Alternative Reference Number: | **34-210** |
| Area of Applicability: | **Engineering** |
| Documentation Type: | **Standard** |
| Revision: | **2** |
| Total Pages: | **43** |
| Next Review Date: | **September 2022** |
| Disclosure Classification: | **Controlled Disclosure** |

| Compiled by | Approved by | Authorized by |
|---|---|---|
| Queeneth Khumalo | Thinus du Plessis | Bheki Ntshangase |
| HV Plant: Cable Systems Chief Engineer | HV Plant: Cable Systems Chief Engineer Convener | HV Plant: Senior Manager Engineering |
| Date: 07-09-2017 | Date: 08/09/2017 | Date: 8/9/2017 |

Supported by SCOT/SC

Thinus du Plessis

CS&MES SC Chairperson

Date: 08/09/2017

PCM Reference: **Technical Documentation**

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

# Content

**Figures**

# 1. Introduction

This specification has been compiled in order to promote the standardisation, rationalisation and testing of medium voltage ring main units (RMUs) and RMUs with integrated control plant solution (IRTU fitted RMUs) consisting of remote terminal unit (RTU) and defined Protection systems, as used in Eskom for free standing metal enclosed indoor and outdoor applications. The IRTU fitted RMUs are intended for distribution automation and independent power producer (IPP) applications. Furthermore, the following are also introduced; high risk enclosure designs and 36 kV rated units for Generation non-standard applications and Distribution standardised applications.

# 2. Supporting clauses

## 2.1 Scope

This specification covers Eskom's requirements for new factory-assembled RMUs and IRTU fitted RMUs that are rated for use on three-phase cable systems for rated voltages from 3.6 kV up to and including 36 kV, and are designed for freestanding indoor or outdoor operation at a rated frequency of 50 Hz. The specification distinguishes between ring main units used for inland and coastal applications. This scope excludes bulk metering kiosks.

### 2.1.1 Purpose

The purpose of this document is to specify the requirements for RMUs and IRTU fitted RMUs to be used in Eskom for free standing applications.

### 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] 240-70413291 (DSP 34-253), Specification for electrical terminal blocks.

[3] 240-64685228 (DST 34-333), Generic Specification for Protective Intelligent Electronic Devices (IEDS).

[4] 240-85224724 (DSP 34-462), Standard For Distribution Protection Schemes: Common Requirements.

[5] 240-61268576, Standard for the interconnection of embedded generation.

[6] 240-71084644, Pole Mounted Auto Reclosers General and Protection Requirement Standard.

[7] 240-56030619 (DSP 34-1622), Accessories for medium-voltage power cables for systems with nominal voltages of 11kV to 33kV.

[8] 240-75655504, Corrosion protection standard for new indoor and outdoor Eskom equipment, components, materials and structures manufactured from steel standard.

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

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

[11] SANS 1507-2, Electric cables with extruded solid dielectric insulation for fixed installations (300/500 V to 1 900/3300 V) – Part 2: Wiring cables.

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

[13] SANS 61869-3, Instrument transformers Part 3: Additional requirements for inductive voltage transformers.

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

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

[16] SANS 1332, Accessories for medium voltage XLPE and impregnated paper insulated power cables (3.8/6.6 kV to 19/33 kV).

[17] SANS 1339, Electric cables cross linked polyethylene (XLPE) insulated cables for rated voltages 3.8/6.6 kV to 19/33 kV.

[18] SANS 1520, flexible electric trailing cables for use in mines: part 2 high voltage (3.8/6.6 kV to 19/33 kV) cables.

[19] SANS 62271- 202, High voltage switchgear and control gear part 202: high voltage / low voltage prefabricated substation.

[20] SANS 62271- 200, High voltage switchgear and control gear part 200 AC metal enclosed: ac metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.

[21] D-DT-0863, Free-standing ring main unit plinth details.

[22] D-DT-3202, ABC MV danger sign.

[23] D-DT-6073, Sign DE first aid.

[24] D-DT-8019, Cable clamp black poly-propylene.

[25] D-DT-8027, Rubber cable grommet.

[26] D-DT 8029, Sealant strip for mini subs and RMUs.

[27] 240-75655504: Corrosion protection standard for new indoor and outdoor Eskom equipment, components, materials and structures manufactured from steel standard.

[28] 240-97690165 (DSP 34-2123): Specification for telecontrol requirements for ring main units.

[29] 240-64038621, Remote device communication standard for data retrieval and remote access

[30] D-DT8060, Buyer’s guide for RMU 11 kV and 22 kV outdoor stand alone.

[31] D-DT8061, Buyer’s guide for RMU 11 kV and 22 kV out door and in door IRTU.

### 2.2.2 Informative

[32] 32-9: Definition of Eskom documents.

[33] 32-644: Eskom documentation management standard.

[34] 474-65: Operating manual of the Steering Committee of Technologies (SCOT).

## 2.3 Definitions

### 2.3.1 General

The definitions in SANS 1874 and the following shall apply.

| Definition | Description |
|---|---|
| **Definite time lag (DTL) protection element** | A protection element with a settable time delay that is constant above the pick-up current setting. |
| **Instantaneous protection element** | An element with no intentional time delay active above a pre- determined pick-up current setting. |
| **Integrated Remote Terminal Unit (IRTU)** | The term IRTU has been used in this document to denote a Ring Main Unit (RMU) fitted with an integrated control plant solution consisting of a remote terminal unit (RTU), integrated with either a Self- Powered Protection Relay (SPR) or Protection IED as required |
| **Intelligent electronic device (IED)** | A microprocessor-based device that encompasses all or some of the following functionalities: protection, control and automation, metering, tele-control, substation DC and auxiliary supply systems, quality of supply monitoring, and disturbance and event recording. |
| **Inverse definite minimum time (IDMT) protection element** | A protection element of which the minimum operating time is adjustable and is inversely proportional to the fault current. |
| **Negative phase sequence (NPS) protection** | Protection intended to operate when the negative sequence component of the system current phasors is in excess of a predetermined value. |
| **Ring main unit (RMU)** | A medium voltage metal-enclosed switchgear assembly that comprises a combination of switch-disconnectors, switch-fuse combinations or circuit-breaker functions. These functions incorporate integral cable earthing switches and have facilities for cable testing. |
| **Supervisory (SCADA)** | Remote control and visibility of the RMU by means of an RTU and a telecommunications link. |

### 2.3.2 Disclosure classification

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

## 2.4 Abbreviations

For other abbreviations: SANS 1874 shall apply.

| Abbreviation | Description |
|---|---|
| **AC** | Alternating Current |
| **BTU** | Battery Tripping Unit |
| **CT** | Current Transformer |
| **CVT** | Capacitive coupled Voltage Transformer |
| **DC** | Direct Current |
| **DTL** | Definite Time Lag |
| **E/F** | Earth Fault |

| Abbreviation | Description |
|---|---|
| **EI** | Extremely Inverse |
| **HMI** | Human Machine Interface |
| **IDMT** | Inverse Definite Minimum Time |
| **IEC** | International Electrotechnical Commission |
| **IED** | Intelligent Electronic Device |
| **IRTU** | Integrated Remote Terminal Unit |
| **LV** | Low Voltage (< 1000 V) |
| **MCB** | Miniature circuit-breaker |
| **MV** | Medium Voltage (1000 V to 44000 V) |
| **NI** | Normal Inverse |
| **PC** | Personal Computer |
| **RMS** | Root Mean Square |
| **RMU** | Ring Main Unit |
| **RTU** | Remote Terminal Unit |
| **SANS** | South African National Standard |
| **SCADA** | Supervisory Control And Data Acquisition - “Supervisory” |
| **SPR** | Self- Powered Protection Relay |
| **VDS** | Voltage Detection System |
| **VI** | Very Inverse |
| **VLF** | Very low Frequency |
| **VT** | Voltage Transformer |
| **XLPE** | Cross linked polyethylene |

## 2.5 Roles and responsibilities

All Eskom employees and/or appointed bodies involved in the procurement of the RMUs and IRTU fitted RMUs, shall ensure that the project deliverable meets the requirements of this standard. Any deviation from these requirements shall constitute non-conformance, unless it was agreed in advance by a delegated Eskom Cable Systems Specialist and is based on sound engineering judgement.

All suppliers of RMUs and IRTU fitted RMUs to Eskom must be conversant with the requirements of this standard, and shall comply with the requirements herein. No deviations will be accepted, suppliers shall ensure that they obtain all supporting information or documents necessary to comply with this document, and obtain clarity if required.

## 2.6 Process for monitoring

The following documents will be used for process monitoring; technical evaluation criteria, and technical schedule A and B as per the requirements of SANS 1874.

## 2.7 Related/supporting documents

Not applicable.

# 3. Requirements

## 3.1 General

RMUs and IRTU fitted RMUs shall comply with the requirements of SANS 1874 and this specification. Where conflicting requirements arise, the requirements of this specification shall take precedence.

### 3.1.1 Ring main unit standard configurations

Standard indoor and outdoor free-standing RMU configurations are given in the Eskom buyers guide drawing D-DT-8060, and standard indoor and outdoor IRTU fitted free-standing RMUs are given in the Eskom buyers guide drawing D-DT-8061.

**Note:** The configuration is specified using the abbreviation for each switching device located on the ring main unit from left to right as viewed from the front, with a hyphen separating each switching device. The following abbreviations are used: 'R' for a switch disconnector; 'F' for a switch-fuse combination and 'B' for a circuit-breaker. Hence, a ring main unit that contains a switch disconnector, a circuit-breaker, a switch-fuse combination and a switch disconnector located from left to right as viewed from the front, would be specified as 'R-B-F-R'. Where the specific order of the configuration is not important, the switching device types may be grouped together. The previous configuration would then be specified as '2R-B-F'.

## 3.2 Rated lightning impulse peak withstand level

The rated lightning impulse peak withstand level shall be in accordance with "List 3" of table 1 given in SANS 1874 for 12 kV rated RMUs and "List 2" of table 1 given in SANS 1874 for 24 kV and 36 kV rated RMUs.

## 3.3 Cable test facilities

a) In accordance with SANS 1874.

b) 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).

c) The cable test facility need not be capable of being padlocked.

d) 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.

e) A label shall be provided on the cable test facility door or enclosure to state the maximum allowable AC, VLF, RMS and peak test voltage limits that may be applied for up to one hour on the RMU cable test bushings. See SANS 1874.

## 3.4 Remote tripping (hand-held push-button remote control facility)

a) All RMUs and IRTU fitted RMUs shall in addition to manual mechanical operations of the switching devices force spring charging, opening, tripping, closing, earthing and spring charging where applicable, closing also make provision for remote operations of the switching devices for opening, tripping, closing, earthing and spring charging where applicable tripping and closing via a hand-held push-button remote control facility (i.e. trip, open, charge, earth and close pendant control, fitted with a battery pack) as per technical schedule A.

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

c) Details of the provisions required for remote tripping and closing via a hand-held push-button remote control facility as per technical schedule A (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).

## 3.5 Fuse-links for switch-fuse combinations

a) The length of fuse-links for switch-fuse combinations shall be 442 mm.

b) Fuse-links shall be encapsulated and not exposed to environmental pollution. The insulation requirements shall be in accordance with SANS 876.

c) The switch-fuse rating shall be provided based on the maximum size fuse rating that will be allowed to be fitted for the rated voltage of the RMU, this shall be provided with the available maximum short circuit current withstand rating type tested if different to what is specified. If the cable earth switch has a lower three phase short current withstand rating in comparison to the RMU three phase short circuit current withstand rating, then the cable earth switch fault current rating limit shall be stated for the fused functional unit.

d) The switch rating of the switch-fuse combination shall be provided with the available maximum short circuit current withstand and the short circuit making rating type tested if different to what is specified.

## 3.6 Protection equipment requirements for MV Circuit breaker

The following Protection systems shall be applied to each MV circuit breaker of the following RMU types:

a) RMUs, shall have a Self-Powered Protection Relay (SPR) as detailed in 3.6.1 installed on each circuit breaker,

b) IRTU fitted RMUs, shall have either a Self-Powered Protection Relay (SPR) as detailed in 3.6.1 and 3.6.2 or a Protection IED as detailed in 3.6.3, installed on each MV circuit breaker, as required by user,

c) SPRs and Protection IEDs shall be in accordance with 240-64685228, 240-85224724,

d) Wiring and Terminations shall be in accordance with clause 3.10.5 - 13 of 240-85224724.

### 3.6.1 Self-Powered Protection Relay (SPR)

Details of Self Powered Protection Relay (SPR) for RMUs & IRTU fitted RMU's. The SPR shall have the following Protection functions in accordance with clause 4.2 of 240-85224724:

a) Instantaneous Overcurrent Protection – I>> (PIOC1) , with definite time DTL characteristic,

b) Instantaneous Earth Fault Protection – $I_o$>> (PIOC2- Residual Overcurrent), with definite time DTL characteristic,

c) Time Delayed Overcurrent Protection – I> (PTOC1), comprising the following IDMT overcurrent characteristics: normal inverse, very inverse, extremely inverse; and definite time (DTL) protection elements,

d) Time Delayed Earth Fault Protection– $I_o$> (PTOC2 - Residual Overcurrent), comprising the following IDMT overcurrent characteristics: normal inverse, very inverse, extremely inverse; and definite time (DTL) protection elements,

e) The setting ranges (pick-up settings, time multipliers, delay times) and resolutions of the time delayed over-current, earth fault and high-set instantaneous protection elements shall be in accordance with 240-85224724, and shall be stated in Schedule B,

f) The minimum earth fault pick-up current shall be 40 A primary, and shall be independent of the CT ratio selected. Details of how this will be achieved shall be provided in schedule B.

#### 3.6.1.1 SPR General Requirements

a) As the Self Powered Relay is dependent on presence of load current as power source, the SPR shall power up from minimum of < 20% of it's rating with 3 Phase load current present, and minimum of < 40% of it's rating for 1 Phase load current present, confirmation shall be provided in schedule B,

b) The SPR shall include an HMI with a Display to allow for visual display of 3 Phase Load currents, protection settings, fault records, event logs and allow for the application of protection settings,

c) Application of Protection Settings shall be done via software or HMI, and shall include password protection functionality according to clause 3.15.2 of 240-64685228. SPRs using external DIP Switches or Potentiometers for the application of Protection settings will not be accepted,

d) The Software and firmware requirements shall be according to 3.6.3.10 below,

e) A time and date stamped sequence of event recorder (SER) storing at least the last 5 trip events with a minimum resolution of 5 ms shall be provided with the SPR. The real-time internal clock shall be in accordance with clause 3.17 of 240-64685228,

f) The Protection system of SPR, CT and Trip Coil combination, shall operate according to detailed specification up to the rated short-circuit breaking current of the MV circuit breaker. Proof of this performance shall be provided,

g) The SPR shall be positioned and installed in such a way that it is possible to exchange it with minimal effort and tools,

h) The SPR and associated terminals shall be easily accessible from the front of the RMU i.e. for testing purposes,

i) The SPR, and associated current sensors or current transformers shall be installed and wired complete for service,

j) The vendor shall be responsible to configure the SPR per an approved settings template, and shall perform routine tests using primary current injection to verify protection system operation prior to delivery.

#### 3.6.1.2 CT requirements for SPR:

Where the tripping of the MV circuit breaker shall be through a self-powered Protection Relay (SPR) the following CT requirements shall apply:

a) For the 200 A MV circuit breaker, the current transformers (CTs) shall be of the multi-ratio type, with ratios of 200/100:1 A. If alternative CT ratios are required, they shall be specified in schedule A,

b) For the 630 A MV circuit breaker, the current transformers (CTs) shall be of the multi-ratio type, with ratios of 400/200:1 A. If alternative CT ratios are required, they shall be specified in technical schedule A,

c) CT's shall be in accordance with SANS 61869-2.

Alternative options for CT sensor technology maybe submitted for Eskom evaluation and review at time of tender.

### 3.6.2 Details of Self Powered Protection Relay (SPR) for IRTU fitted RMU's

Where IRTU fitted RMUs, require a self-powered protection Relay (SPR) applied to the MV circuit breaker, the SPR and it's CT's shall be per 3.6.1 above (for RMUs), and shall include the following additional functionality:

a) The SPR shall be capable of being powered by the IRTU DC supply, and capable of automatically reverting to it's self-powered mode should the DC supply fail,

b) The SPR shall include serial SCADA inter-face capability, so that the analogues values of phase currents and status alarms are made available to the RTU via a serial connection as per 240-97690165,

### 3.6.3 Details of Protection IED for IRTU fitted RMU's

IRTU fitted RMU's requiring Protection IED's are intended for more advanced distribution automation requirements and independent power producer (IPP) applications, and thus the Protection IED shall satisfy the specific Protection requirements as detailed below and be in accordance with 240-71084644 Part 2 (Telecontrol requirements), 240-64685228 and 240-85224724.

#### 3.6.3.1 General Protection functional requirements

a) A harmonic current inrush restraint function, approved by the purchaser, shall be supplied. The supplier shall describe the method offered in the tender documentation,

b) The ratio of drop-off current to pick-up current shall be at least 95 % for all protection functions (Idrop-off / Ipick-up x 100% ≥ 95%),

c) The E/F function shall be equipped with harmonic filtering to prevent operation when harmonics are present in the primary residual earth currents. A low-pass filter shall be supplied, with:

   1) 2nd harmonic rejection > 6 : 1, and

   2) 3rd harmonic rejection > 50 : 1.

d) All protection functions, i.e. overcurrent (O/C), and earth fault (E/F) shall include elements with characteristics that comply with IEC 60255 -151:

   1) Resetting of a picked-up IDMTL or DTL protection function (O/C, and E/F) by simulating the reset time of an electromechanical protection relay,

   2) The preferred method of disk reset shall be in according with IEC 60255-4 Class A, Class B, Class C, Long-time inverse and Short-time inverse reset curves,

   3) An alternative method maybe a user defined DTL reset time (settable between 1s and 20 s),

   4) The function shall be user selectable.

e) Protection Time Current Curves (TCC) shall be selectable from standard IEC and ANSI TCC libraries. The plug setting and the time multiplier shall be selectable from the same window in the User Configuration Software.

#### 3.6.3.2 Overcurrent function

a) Delayed protection operation shall be possible by selecting an IDMTL protection element with normal inverse (NI), very inverse (VI) or extremely inverse (EI) curve or a definite time protection element with time delay from 0,05 s to 10 s, in 0,05 s steps, in accordance with IEC 60255 -151,

b) Overcurrent pick-up setting range shall be selectable from 50 Amps primary, to at least twice the rated load current of the circuit-breaker in step sizes not greater than 10 Amps, offered setting ranges and step sizes to be stated in schedule B,

c) Rapid protection operation shall be possible by selecting a fast curve or a DTL protection element,

d) Co-ordination of the rapid protection elements between two devices in series shall be possible either by selecting suitable curves from a family or by addition of a selectable time increment, typically 0,05 s to 3 s, in 0,05 s steps, or any other Eskom acceptable solution,

e) Long protection operating times associated with fault levels marginally above the pick-up setting of the IDMTL protection element shall be avoided by the provision of a Low Set Definite Time element with the following features:

   1) It shall be possible to enable or disable the element. When enabled it shall be active simultaneously as an overlay with all selected elements,

   2) The element shall have the same pick-up current setting as the IDMTL element; and

3) The time delay shall be selectable from 1 s to 10 s, in 1 s steps. The time delay shall be independent of any curve manipulation.

f) A High Set Instantaneous element with a selectable time delay shall be provided, with the following features:

1) It shall be possible to enable or disable the element. When enabled it shall be active simultaneously as an overlay with all selected elements;

2) The pick-up setting range of this element shall be at least 100 % to 3000 % of the overcurrent setting and shall be independent of any curve manipulation; and

3) The time delay shall be selectable from instantaneous to 2 s, in 0,01 s steps. The time delay shall be independent of any curve manipulation.

g) A cold load pick-up (CLP) feature shall be provided that allows user selectable modification of protection element characteristics under conditions of system energization. The CLP function may be provided in one of the following two ways:

1) The pick-up current setting of the IDMTL O/C element and the Low Set Definite Time O/C element may be modified with a settable factor to increase the pick-up current of these elements for the CLP duration. The rapid O/C element should be blocked for this time.

2) The rapid O/C element and the Low Set Definite Time O/C element could be blocked for the CLP time duration; and

h) The CLP function shall have the following characteristics:

1) The CLP function shall not in any way interfere with any of the other functions/'elements' pick-up current settings except as mentioned above,

2) The CLP functionality shall be such that the active duration of the CLP is selectable from 0 min to 120 min in 1 min steps, and

3) The modification factor for the O/C element should be settable from 1 to 2 in steps of 0, 1. Alternatively an automatic intelligent method of CLP may be applied whereby previous load and outage time is taken into account when modifying the O/C element dynamically.

#### 3.6.3.3 Earth fault function

a) The earth fault setting range shall detect primary earth fault currents down to 10 A, with offered setting ranges to be stated in schedule B,

b) Delayed protection operation shall be possible by selecting an IDMTL element with NI, VI or EI curve, or a definite time protection element with time delay from 0,05 s to 10 s, in 0,05 s steps, in accordance with IEC 60255,

c) Rapid protection operation shall be possible by selecting a fast curve or a DTL protection element. Co-ordination of the rapid protection elements between two devices in series shall be possible either by selecting suitable curves from a family or by addition of a selectable time increment, typically 0,05 s to 3 s, in 0,05 s steps, or any other acceptable solution,

d) A High Set Instantaneous element with a selectable time delay shall be provided with the following features:

1) It shall be possible to enable or disable the element. When enabled it shall be active simultaneously as an overlay with all selected elements,

2) The pick-up setting range of this element shall be at least 100 % to 1500 % of the earth fault setting and shall be independent of any curve manipulation; and

3) The time delay shall be selectable from 0, 05 s to 1 s, in 0, 05 s steps. The time delay shall be independent of any curve manipulation.

#### 3.6.3.4 Directional Power function

The offer shall include the following Directional Power capability

a) Two Directional power elements, capable of detecting real (Watts) and reactive (VARS) Power flow in the reverse or forward direction.

b) Each directional power element shall have a Definite Time characteristic.

#### 3.6.3.5 Live Load Blocking

a) The Live Load Blocking feature shall be user selectable: i.e. available/ not available,

b) The Live Load blocking shall be switchable: i.e. On/Off,

c) If Live load blocking is selected ON, it shall not be possible to close the circuit breaker if voltage is detected on the load side of the circuit breaker (“Line Alive”),

d) Live load primary pick-up setting range shall be selectable from 2000 V to rated voltage of the device in steps of 100 V or better. An alternative method of providing live load detection may be accepted upon agreement with purchaser.

#### 3.6.3.6 Negative phase sequence protection (NPS)

a) The primary pick-up setting range shall be selectable from 1 A to 20 A in step sizes not greater than 0,5 A,

b) The time delay shall be a definite time, selectable from instantaneous to 10 s, in steps not greater than 1 s,

c) The NPS function shall be blocked if O/C, E/F function’s starter picks up,

d) The NPS reset time shall be instantaneous,

e) The NPS function shall be user selectable to operate the following outputs:

   1) Alarm output only,

   2) Trip output only,

   3) Both the alarm and the trip outputs.

f) Directional NPS functionality shall be provided.

#### 3.6.3.7 Under- and over-frequency protection

Preference shall be given to relays with the following frequency protection functionality:

a) The frequency protection function shall have an over -and an under-frequency setting with a DTL timer,

b) As the power system frequency drops below the set under-frequency level the DTL timer shall start and initiate a trip. Similarly, as the frequency exceeds the set over-frequency level a trip shall be initiated,

c) A user selectable blocking function should be provided that will prevent the breaker from closing when the measured frequency is outside the under- and over-frequency settings,

d) The frequency protection function shall comply with the following criteria:

   1) The under frequency setting range shall be between 45 Hz and 50 Hz in steps of 0.05Hz,

   2) The over frequency setting range shall be between 50 Hz and 55 Hz in steps of 0.05Hz,

   3) The definite time delay shall be settable with a range of 0 s to 5 s in steps of 0.02 s,

   4) The frequency function pick-up time shall be better than 0.1 s,

   5) The accuracy of the frequency measurement shall be better than ± 10 mHz,

6) The reset time shall be instantaneous,

7) The element shall have a reset difference (i.e. hysteresis) of between 30 mHz and 50 mHz,

8) It is preferred that the element shall include under voltage blocking that is settable between 0.3 and 0.9 x Vn.

#### 3.6.3.8 Under- and over-voltage protection

a) The voltage protection function shall have an over- and an under-voltage setting with a DTL timer.

b) As the power system voltage drops below the set under-voltage level the DTL timer shall start and initiate a trip and/or alarm on timing out. Similarly, as the voltage exceeds the set over-voltage level a trip and/or alarm shall be initiated.

c) The voltage protection function shall comply with the following criteria:

1) The under- & over voltage pick-up setting range shall be between 0 V and 300 V secondary in steps of 0.1 V; the steady-state pick-up accuracy should be ±2V and ±5% of setting,

2) The definite time delay shall be settable with a range of 0 s to 300 s in steps of 1 s,

d) The voltage protection function shall be user selectable to operate the following outputs:

1) Alarm output only,

2) Trip output only,

3) Both the alarm and the trip outputs.

4) Circuit breaker close blocking when measured voltage is outside the under- and over-voltage settings,

e) VT fuse fail supervision is required per sub clause 4.3.13 of 240-85224724, to alarm condition and block operation of Voltage dependent protection functions.

#### 3.6.3.9 IED Measurement functions

The characteristics of the measurement functions shall be as follows:

a) Measurements shall be done using the three-phase four-wire (3P4W) method. The measurement system shall therefore utilise three current sensors to measure line current (red, white and blue phase) and three bus bar voltage sensors measuring phase-to-neutral voltages (red-to-neutral, white-to-neutral and blue-to- neutral),

b) The following measurement quantities shall be measured/calculated, and the specific detail and accuracy thereof shall be per clause 3.8.1.2 of 240-71084644:

1) Voltage (r.m.s.) [kV]: phase-to-phase and phase-to-neutral voltage of all three phases on the busbar and the load side of the circuit-breaker,

2) Current (r.m.s.) [A]: line current per phase,

3) Active power [kW]: per phase and three-phase power,

4) Apparent power [kVA]: per phase and three-phase power,

5) Reactive power [kVAr]: per phase and three-phase power,

6) Active energy [kWh]: three-phase energy,

7) Reactive energy [kVArh]: three-phase energy,

8) Power factor: leading or lagging magnitude shall be indicated,

9) Maximum demand: for the quantities in 3) and 4), as indicated above.

c) It will be preferred if peak current measurements are recorded when a user selectable threshold value is exceeded. The maximum value attained, duration that threshold exceeded, the time and date of occurrence should be recorded,

d) The energy and maximum demand measurements shall be integrated with respect to time, with selectable time integration periods of 15 min, 30 min or 60 min. These integrating periods shall not be of a “sliding window” type but will be fixed block intervals starting on the hour,

e) The data buffer for the energy and maximum demand measurements shall work on the FIFO principle and a minimum size for the data buffer shall store values for 4 months on the 30 min integration period,

f) The ability to display (locally and remotely to SCADA) the following quantities will be preferred, inclusive of their magnitude and phase angle:

1) Positive phase sequence voltage,

2) Negative phase sequence voltage,

3) Zero phase sequence voltage,

4) Positive phase sequence current,

5) Negative phase sequence current, and

6) Zero phase sequence current.

#### 3.6.3.10 IED Event and Disturbance recorder

a) IED shall include a disturbance recorder per clauses 4.3.1, 4.3.2 and 4.3.3 of 240-61266445,

b) IED shall include a sequence of event recorder that can log any settings change; settings group change, protection pickup or trip operation, change in circuit-breaker state and/or input and output status. Local and remote control actions (both manual and automatic) shall be logged,

c) The sequence of event recorder shall be capable of recording the maximum phase and neutral currents associated with over current, earth fault protection “pick-up and trip” and “pick-up and drop-off” events,

d) The signals whose state changes are to be captured in the sequence of event recorder shall be programmable,

e) Events shall be date and time stamped to 1 ms resolution relative to the on-board real time clock and shall be recorded sequentially and chronologically. The year shall be recorded as a four digit number,

f) The naming of the events in the event recorder shall be consistent with those used on HMI and those reported via the communications protocol,

g) Shall store at least 1 000 events. Events shall be stored using the First In – First Out principle,

h) To enable uploading of the event data without re-loading of previously loaded data, the following is required,

i) The default upload standard shall be such that the configuration software shall first establish up to which point the event recorder of the particular device was last read and then only download the more recent events,

1) The block of events that must be uploaded shall be user selectable with a defined stop and start date, and

2) Registers shall not clear automatically after uploading of data.

j) It shall be possible to save the sequence of events download from the IED in xml (e.g. COMFEDE as require in IEC 60255-24) and Comma Separated Value (CSV) or text formats. Sequence of event lists which can only be viewed using vendor-proprietary software are not acceptable.

### 3.6.3.11 Configuration software and Firmware

a) The IED shall be fully configurable from a PC, utilising the configuration software,

b) Configuration software is regarded as an integral part of the IED and should therefore be included as part of the product offering at no additional cost,

c) The configuration software shall be compatible with at least one Microsoft Windows Operating System less than 2 years old and another that is between 2 and 5 years old,

d) Configuration software releases shall be fully backward compatible with Protection IED offered of the same range, which is less than 15 years old,

e) A copy of the configuration software shall be submitted with the tender documentation,

f) Software and Firmware version control require that the approved software and firmware versions at time of tender shall not be changed by the vendor without written approval from Eskom. The release of future (i.e. after initial evaluation and acceptance) versions of software and firmware to Eskom shall be in accordance with Unique Identifier 240-64685228,

g) All future updates of configuration software and firmware shall be made available to Eskom at no additional cost,

h) It shall be possible to perform future firmware upgrades via the local communication ports. Firmware upgrades involving EPROM replacement are not acceptable,

i) In the event of a change request being initiated by the supplier, all costs, except for those associated with witnessing/ verification by Eskom staff, but including power system simulator testing (where applicable) shall be for the supplier's account,

j) The supplier shall inform Eskom of any firmware or hardware update that becomes available for use by Eskom, specifically where the update relates to a problem or deficiency which may affect its reliable or safe operation,

k) The supplier shall provide the Eskom technical representative with reasons for the change, and shall include details thereof, and declare all associated effects (e.g. impact on performance, communications, settings, and interoperability with previous versions),

l) Eskom shall not be obliged to undertake the evaluation of new firmware versions or new versions of hardware for each new version released by the supplier. This decision shall be taken by Eskom's appointed technical representative,

m) Updated firmware or hardware shall not be considered for evaluation by Eskom unless supported by an updated manual describing all new or altered features.

### 3.6.3.12 IED Setting file data exchange

a) The Protection IED application software shall provide an import/export facility that will allow for protection settings and configuration data to be exchanged with a third-party settings management software database. The Purchaser uses DigSilent Station Ware for this purpose,

b) The Supplier shall demonstrate the bidirectional exchange of data between the protection settings and configuration software and a Microsoft Excel spreadsheet,

c) The file format for settings file data exchange shall be open source and made available to other software developers,

d) Acceptable formats for the data exchange are:

1) ASCII text file,

2) *.xml file format with published style sheets,

3) Microsoft Excel file format,

4) Extended Relay Interface by Omicron (XRIO) format, and

5) Comma Separated Value (CSV) file format.

e) The Supplier shall provide Microsoft Excel-based setting sheets for the Protection IED with separate columns for the setting name, actual setting, and setting range and step sizes. The Excel worksheet shall be equipped to export settings into a format suitable for direct import into the Protection IED setting/ configuration software.

f) The Supplier shall provide a setting template for application with DigSilent Station Ware settings management software.

#### 3.6.3.13 General IED requirements

a) The IED, current and voltage sensors shall be installed and wired complete for service,

b) The protection system offered (i.e. CTs, VT's, IEDs, DC, etc.), shall be capable of operating up to the short circuit current rating of the RMU,

c) The IED shall include an HMI with a Display to allow for visual display of 3 Phase Load currents, protection settings, and fault records,

d) The control system shall prevent closing of the circuit-breaker, if the DC supply (battery) lacks sufficient capacity to trip the circuit-breaker for a protection trip condition. Details must be stated in the tender documentation,

e) Trip circuit supervision shall be provided and it shall monitor the trip circuit for both the open and closed positions of the circuit-breaker,

f) Provision shall be made for integration of an external trip function, wired from X2. Terminal rail to a binary input of the protection IED,

g) Provision shall be made for integration of a binary output (Trip) from the protection IED, wired to X2. Terminal rail,

h) The vendor shall be responsible to configure the protection IED per an approved settings template, and shall perform routine tests using a combination of primary and secondary injection to verify protection system operation prior to delivery.

### 3.6.4 Current Sensor requirements for Protection IEDs

a) Current sensors shall comply with IEC / SANS 61869,

b) MV Circuit-breakers shall be supplied with one current sensors per phase (e.g. CTs, Rogowski coils, etc.), the output thereof to be integrated to the associated Protection IED,

c) The current sensors shall be sufficient to ensure that all the Protection and Measurement requirements specified in this standard for the IED are satisfied and that the Protection system (CT in conjunction with IED etc.) shall be capable of operating correctly up to the rated short-circuit breaking current of the circuit breaker. Proof of this performance shall be provided,

d) Current sensors with an accuracy of class 0.5, as defined in IEC 61869, shall be preferred,

e) Types test certificates and reports according to IEC 61869 for the type and rating of Current sensors offered shall be submitted.

### 3.6.5 Voltage sensor requirements for Protection IEDs

a) Voltage sensors shall comply with SANS / IEC 61869,

b) Voltage sensors (i.e. VTs, CVTs, etc.) shall be provided one per phase, on the bus bar side and on the load side of each MV circuit breaker,

c) Voltage sensors with an accuracy of class 0.5 as defined in IEC 61869 shall be preferred,

d) It is preferred that the voltage sensors are an integral part of the RMU,

e) The voltage sensors shall be sufficient to ensure that all the voltage dependent Protection and Metering requirements specified in this standard for the Protection IED are satisfied and that the Protection system (VT in conjunction with IED etc.) shall be capable of operating correctly up to the rated Voltage of the RMU. Proof of this performance shall be provided, and

f) Type test certificates and reports according to IEC 61869, for the type and rating of voltage sensors offered shall be submitted.

## 3.7 RTU requirements

In addition to the requirements of SANS 1874, the following shall apply:

a) The RTU shall comply to 240-97690165,

b) The RTU shall be capable of accommodating the communication of SCADA information from multiple SPR's or Protection IED's as defined per the user selected options, and

c) The Eskom preference for IRTU communication equipment shall be fibre optic modems or GPRS modems. Where digital radios are required, these will be accommodated, however no provision for mounting of Antennae masts onto the RMU Kiosk enclosure is considered. The relevant OU will be responsible for the design and installation of the free standing mast adjacent to the RMU and for the installation of the antennae and associated cabling.

## 3.8 DC Supply Requirements

In addition to the DC supply requirements for the RTU as detailed in 240-97690165 clause 3.1.2.7 and the battery supply requirements detailed in 240-97690165 clause 3.1.2.8, the following shall apply:

a) The DC supply shall include sufficient capacity to satisfy supply for powering of all Protection and Control equipment (SPR, Protection IED, RTU, communication equipment etc.) as defined per the user selected options. Details of the battery capacity calculation shall be provided, indicating the load profile on which the calculation was based including all compensating factors,

b) Batteries shall be automatically disconnected at the manufacturer's specified minimum voltage and automatically reconnected when auxiliary power is restored,

c) The battery shall:

   1) Be capable of providing a minimum of 80% of its capacity after 4 years. Details of the calculations to verify this life expectancy of the battery shall be stated in the tender documentation,

   2) Be capable of 200 cycles at 100% depth of discharge over 4 years,

   3) Be capable of at least five consecutive close operations and five consecutive open operations during the last 50% of useful capacity,

   4) Meet the requirements above over the full operating temperature range specified per 3.9 h) below,

d) DC circuits shall be protected by suitable rated MCB's, (fuse technology will not be accepted).

## 3.9 Control Plant Enclosure Requirements for IRTU fitted RMUs

a) The RTU and all its associated equipment (i.e. Battery Charger, Battery, communication equipment etc.), shall be housed inside a separate Control Plant enclosure,

b) The Control Plant enclosure shall be mounted onto the side of the RMU enclosure for outdoor applications and onto the RMU for indoor applications, in a manner that will not compromise the internal arc rating of the RMU,

c) The routing of LV control wiring/ cabling between the RMU and the control plant enclosure shall be done in a manner to protect the control wiring without compromising the integrity of the control plant enclosure or the internal arc rating of the RMU,

d) Provision shall be made for a LV Cable ducting system with minimum 100 mm x 50 mm aperture, to accommodate the concealed routing of external LV control cabling i.e. LV supply, Fibre Optic and Antennae Cabling etc., with preference for concealed entry (from below ground level) and routing of such ducting within the RMU enclosure,

e) Where Protection IED's are required, such shall also be mounted within the control plant enclosure, and the position thereof shall be such to allow ease of operation and removal (minimal effort and tools required ,if replacement necessary),

f) Electronic modules shall be suitably protected against voltage surges. Details of the on-board surge protection shall be provided in the tender documentation,

g) The equipment housed inside the control plant enclosure shall be capable of withstanding the heating effect of direct solar radiation on the enclosure, without causing failure and/or mal-operation of the equipment housed within,

h) The maximum expected temperature inside the control cabinet, under the service conditions defined in clause 3.1.1 of 240-71084644, shall be stated in the tender documentation. An explanation of how this temperature was calculated or estimated shall also be provided, and

i) An effort shall be made to conceal and secure items that are prone to theft i.e. Batteries, Modems etc.

## 3.10 Plant status and controls

a) A 52B auxiliary contact from each isolator and circuit breaker shall be wired out separately to X2 terminal rail to allow for cabling out of plant status,

b) Circuit breakers shall be provided with following Trip Coils :

1) A Main trip coil to allow for suitable integration of the Trip signal from the Protection equipment, this trip coil shall be wired via 52 A Aux contact to the trip output of SPR or Protection IED,

2) Option for a second/ backup Trip Coil as detailed in schedule B, where required this to be suitably wired via 52 A Aux contacts, to dedicated terminals to allow for cabling out.

c) The operate Indication status (N/O) from the Earth Fault Indicator, shall be wired out to dedicated terminals.

## 3.11 Terminals and wiring

a) All wiring, terminals & terminations shall be in accordance with clauses 3.10.5 to 3.10.13 of 240-85224724,

b) All terminals shall be of 8 mm (minimum) spring loaded screw clamp in accordance with 240-70413291,

c) A dedicated terminal rail, designated X2.* shall be provided with sufficient terminals to accommodate all functions to be wired out, plus 2 spares. The position of this X2 terminal rail shall allow for easy termination of external cabling,

d) Terminals associated with, trip circuits, current and voltage sensors shall be located on the X2 Terminal rail, and shall in-addition to requirements of a) above, be of the Link type terminal and capable of accepting 4 mm Ø Banana test plugs either side of the link.

## 3.12 LV AC power supply for Control Plant equipment

a) All IRTU fitted RMUs shall be supplied with a suitably rated NS type High Rapture Capacity (HRC) fuse connection point to accommodate supply from a 230 V 30 kA AC external LV power source , to power the power supplies for Control Plant equipment i.e. battery charger etc, and shall be wired to dedicated terminals on X2 terminal rail,

b) IRTU fitted RMUs requiring a LV external supply, shall be pre-wired with a 3 m length LV cable that is coiled, capped and situated in the back of the MV cable termination compartment. This will allow jointing to the LV external source where required,

c) If a dual phase VT is required , for an auxiliary LV AC power supply, this shall be specified in technical schedule A at the time of tender, this shall be in accordance with SANS 61869-3, SANS 1332, and SANS 1339 or SANS 1520-2, and shall be supplied and fitted to provide the LV auxiliary power supply. The secondary AC voltage, burden and Voltage Factor of the VT shall be specified in schedule B,

d) If an auxiliary power supply (VT) is specified per 3.12 b), in-addition to the external LV power supply per 3.12 a) above, an AC supply selector switch shall be provided to segregate these two AC supplies (to prevent back feeding i.e. VT),

e) The VT and any MV interconnection shall be fully screened in accordance with SANS 876 (Type 4 arrangement),

f) The VT secondary circuit shall be supplied completely pre-wired using PVC-insulated multi-strand 600/1 000 V cable with a cross-sectional area of at least 2,5 $mm^2$ per SANS 1507-2,

g) The VT secondary circuit shall be wired to dedicated terminals on X2 terminal rail, and shall include provision of suitable rated MCB for overload protection of VT,

h) The VT installation design details shall be shown in the RMU general assembly drawing,

i) This option for a VT shall only be allowed for outdoor RMUs, and the VT shall be supplied directly from the busbars,

j) A statement shall be submitted on tenders by the RMU suppliers for any Ferro-resonance risk or suitable mitigation systems that can be supplied where VTs are required.

**Note:** The VT supplied from the busbar shall be mounted in the back of the RMU enclosure without interference of the internal arc venting arrangement.

## 3.13 MV Cable termination enclosures

In addition to the requirements of SANS 876, the following shall apply:

a) The ring main unit cable termination enclosures shall be suitable for the termination of 3-core cables of conductor cross-sectional area up to 185 $mm^2$ size or for the termination of three 1-core cables of conductor cross-sectional area up to 300 $mm^2$ size where applicable. Different SAP number items will be used to differentiate between these two options,

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

c) The cable termination enclosure for three 1-core cable terminations shall have a 600 mm minimum bushing centre line spacing distance to the bottom cable entry or bottom entry plate,

d) For the 11 kV ring main units, the minimum spacing between bushing centres and between the outer bushing centres and earthed metal enclosure for unscreened separable connectors shall be 105 mm or (90 mm when screened separable connectors are used) and 55 mm or (50 mm when screened separable connectors are used) 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,

e) For the 11 kV ring main units, the minimum spacing between bushing centres and between the outer bushing centres and earthed metal enclosure for screened separable connectors 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:** The design for 11 kV RMUs shall be used for both the 3.3 kV and 6.6 kV RMUs.

f) For 22 kV and 33 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 and 33 kV, screened separable connectors will be used by Eskom.

g) The range of the cable support clamp (shall be in accordance with SANS 876 and D-DT-8019 where applicable) fitted in each cable termination enclosure shall be:

1) In the case of 3-core cables of conductor cross-sectional area up to 185 $mm^2$ size for both XLPE-insulated cables and paper-insulated cables, suitable for an outer cable diameter of 50 – 100 mm, and

2) In the case of three 1-core cables of conductor cross-sectional area up to 300 $mm^2$ size suitable for an outer cable diameter of 25 – 55 mm. The size of the CT inner diameter shall also cater for the maximum inner diameter requirement of 55 mm.

h) Where low-voltage ring-type current transformers are required for unscreened separable connectors, they shall be positioned so that the minimum distance from the bushing centre line to any part of the highest positioned current transformer is at least 370 mm,

i) Where low-voltage ring-type current transformers are required for screened separable connectors, they shall be positioned so that the minimum distance from the bushing centre line to any part of the highest positioned current transformer is at least 350 mm to accommodate the screen separable connector.

**Note:** The 370 mm dimension is based upon a termination that has been made with a screen cut positioned 200 mm from the end of the cable core insulation (as now specified for “extended screen” indoor terminations in accordance with 240-56030619). The additional 170 mm is required for the torque-shear lug (120 mm) and SANS 876 clearance from the top of the CT to the screen cut (50 mm).

## 3.14 Gas pressure indicating device

The device provided for checking the gas pressure on each tank shall respond to gas density (pressure compensated for temperature).

## 3.15 Live circuit indication

A voltage detection system (VDS) in accordance with SANS 61243-5 shall be provided for all R, B and F functions on RMUs and IRTU fitted RMUs. The VDS units installed on all RMU and IRTU fitted RMU switching device cable compartments circuit breakers panel shall include the functionality to enable interlocking for blocking of any earth switch closing operation switch or circuit breaker open or close function, when the MV cable compartment is alive. This interlocking shall be possible via the IRTU provided back up battery function, and for the RMU via the hand-held push-button remote control facility fitted a battery pack.

**Note:** 1 RMUs operated without the remote operating control unit battery pack will not be interlocked for the earth switch closing operation blocking.

The VDS shall be set to align with the network voltage and not the rated voltage of the RMU (e.g for 3.3 kV networks and 6.6 kV networks).

## 3.16 Earth fault indication

Earth fault indicators (EFIs) shall be in accordance with the following requirements:

a) Earth fault Indicators (EFI) shall be of the CT powered type for MV Cable applications,

b) Earth Fault Indicator sensor shall be placed on the incomer bay of the RMU, and shall be capable of detecting Earth Fault currents > 50 Amps,

c) Provision shall be made for external indication visible from 50 m in daylight i.e. a flashing Red LED, to indicate Earth Fault current detected,

d) For IRTU applications, the EFI shall include a potential free alarm contact for integration with the RTU, to signal detection of MV System Earth Fault condition to remote SCADA system,

e) Resetting of Earth fault Indicator (EFI) shall be possible via the following:

1) Self-reset upon restoration / resumption of normal load current,

2) Automatic reset via user defined reset time,

3) Operator manual reset via a push button or magnet,

f) 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 RMUs.

## 3.17 Kiosk padlock protection facility

a) A padlock protection facility shall be provided for outdoor ring main unit kiosks as shown in Figure 1.

b) The padlock protection facility shall provide access to the padlock from both left and right hand sides.

c) 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.

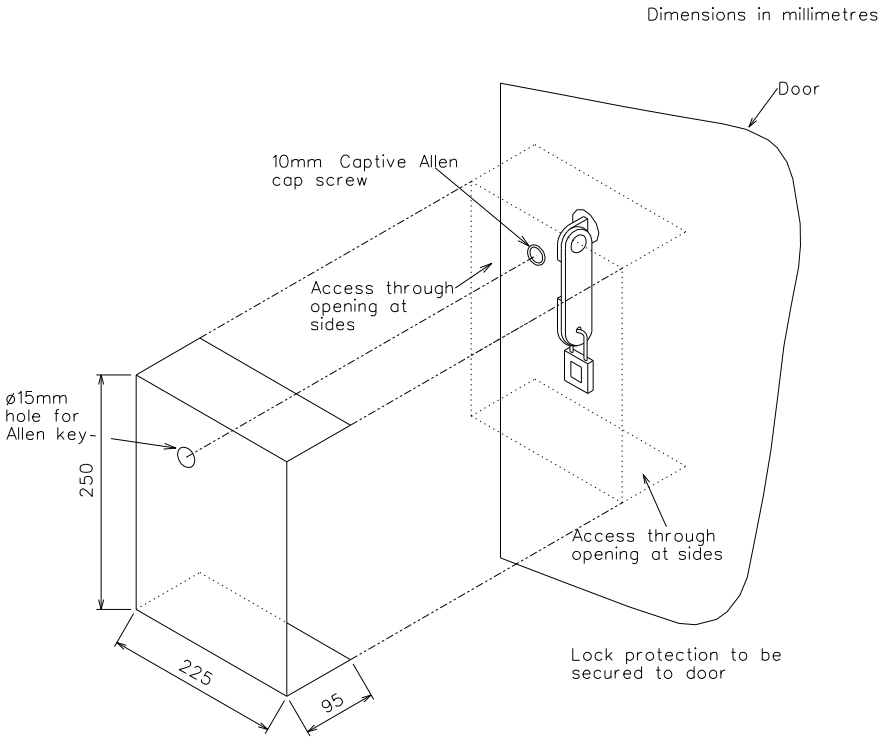


**Figure 1: Outdoor kiosk padlock protection facility**

## 3.18 Outdoor ring main unit concrete plinths

The kiosk and position of the ring main unit within the kiosk shall be suitable for mounting on concrete plinths in accordance with D-DT-0863 for applications up to 22 kV. For 33 kV applications; a suitable plinth design shall be performed on a project to project basis.

## 3.19 Provision for holding down the outdoor ring main unit kiosk

The outdoor ring main unit kiosk base shall have four Ø 24 mm oversized mounting holes; the mounting holes shall be dimensioned and positioned so that they are suitable for M16 holding-down set-screws.

**Note:** Oversized holes are required to in order to make provision for manufacturing tolerances in the concrete plinth holding down positions.

## 3.20 Protection against corrosion (ring main units, kiosks and raising bases)

a) It will be specified in schedule A, whether the ring main unit is required for “inland” or “coastal” environments,

b) For ring main units classified as “inland”, the class of pollution characterising the site severity shall be “c” (i.e. “medium”) in accordance with SANS 60815-1,

**Note:** Pollution class “c” in accordance with SANS 60815-1:2009 is equivalent in pollution class “II” in accordance with SANS/IEC 60815:1986.

c) For ring main units classified as “coastal”, the class of pollution characterising the site severity shall be “e” (i.e. “very heavy”) in accordance with SANS 60815-1,

**Note:** Pollution class “e” in accordance with SANS 60815-1 is equivalent in pollution class “IV” in accordance with SANS/IEC 60815:1986.

d) Corrosion protection of free-standing ring main units shall be in accordance with 240-75655504 with the following specific requirements:

1) Where a ring main unit is specified as suitable for "inland" applications, the corrosion protection requirements shall conform to a "corrosivity rating" of "LOW TO MEDIUM (C2 to C3)" in accordance with table 3 of 240-75655504. The detailed specification (DS) number in accordance with 240-75655504 shall be stated in schedule B,

2) Where a ring main unit is specified as suitable for "coastal" applications, the corrosion protection requirements shall conform to a "corrosivity rating" of "VERY HIGH (C5)" in accordance with table 3 of 240-75655504. The detailed specification (DS) number in accordance with 240-75655504 shall be stated in schedule B.

## 3.21 Documentation to be supplied with each tender

a) 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 tender. This will include the individual RMU and IRTU fitted RMU item Technical Schedules,

b) Drawings: In addition to the drawing requirements specified in SANS 1874, the following information shall be included on the drawings when submitted to Eskom for approval at the time of tender:

1) The general assembly drawing shall make reference, where applicable to the following Eskom drawings: D-DT-8019, D-DT-3202, D-DT-6073 and D-DT-8027,

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 applicable),

4) A drawing depicting the wording of the operating procedure label for the tee-off shall be provided,

5) The general assembly / arrangement drawing shall indicate the position of the VT and MV interconnections used to provide the LV auxiliary power supply to the tele-control equipment (if applicable).

c) 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 tender and/ or pre-qualification, and

d) Any other information or documentation required in the technical evaluation criteria issued at the time of tender.

## 3.22 Tests

a) Ring main units shall be tested in accordance with SANS 1874,

b) VTs (if applicable) shall be tested in accordance with SANS 61869-3,

c) Current and Voltage sensors (if applicable) shall be tested in accordance with the relevant SANS 61869 parts,

d) Internal arc classification test for RMUs: As per the requirements in clause 5.2.4 of SANS 1874 all RMUs fitted within a metal enclosure for outdoor applications shall be tested in accordance with SANS/IEC 62271-202. The following requirements for these tests shall apply:

   1) The tests shall be performed on each RMU manufacturer type offered, and each RMU shall be tested inside the exact RMU enclosure design offered (i.e. same material, dimensions, manufacturing method, manufacturer, manufacturing location, etc),

   2) 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 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,

   3) All type test reports and videos for all applicable IAC AB tests performed in accordance with SANS/IEC 62271-202 and SANS/IEC 62271-200 for the RMU and metal enclosure combinations offered shall be supplied for the Eskom safety review in clause 2) above.

e) RMUs for indoor applications shall be tested in accordance with SANS/IEC 62271-200. The following requirements for these tests shall apply:

   1) The tests shall be performed on each RMU manufacturer type and design offered (i.e. same material, dimensions, manufacturing method, manufacturer, manufacturing location, etc),

   2) All the related SANS/IEC 62271-200 compliant type test reports and type test videos, shall be submitted for the Eskom safety review and technical evaluation.

## 3.23 Marking and labelling

### 3.23.1 Main circuit designation labels

The main circuit designation labels for indoor ring main units shall be blank sandwich-board or equivalent (orange-black-orange).

**Note:** Once engraved, the marking shall be black text on an orange background.

### 3.23.2 Other labels and signs

a) A sign depicting “Treatment and Full First Aid Instructions” in accordance with D-DT-6073 shall be permanently attached to the inside of the door that opens first,

b) External metallic corrosion-resistant electrical symbolic warning signs (warning-flash) in accordance with D-DT-3202 (‘MV’ sign) shall be permanently attached to all the doors. If pop-rivets are used to attach the signs to the kiosk doors, only aircraft (i.e. blind) pop-rivets will be acceptable. Normal pop-rivets are not acceptable. Details of the information to be included on the sign shall be specified in schedule A,

c) 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 in text with black letters at least 10 mm high, on an orange background,

d) A short operating procedure shall be provided for the tee-off indicating the steps required to a) isolate and earth the tee-off and, b) close the tee-off. The operating procedure shall be in text with black letters at least 5 mm high, on an orange background. A drawing depicting the wording of the operating procedure label shall be provided and referenced in schedule B,

e) A label for the cable test facility reinstatement instruction shall be provided. The operating procedure shall be in text with black letters at least 5 mm high, on an orange background. A drawing depicting the wording of the operating procedure label shall be provided and referenced in schedule B.

## 3.24 Spares

As per SANS 1874.

## 3.25 Accessories

a) If a hand-held push-button remote control facility with a portable power supply (BTU) is to be supplied with the RMU, it shall be specified in schedule A. Details of the hand-held remote control facility (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 RMU. This shall be evaluated and reviewed by Eskom during tenders. The sealant is intended for application between the outdoor RMU 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 RMU MV compartment with suitable installation instructions,

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

# 4. Authorization

This document has been seen and accepted by:

| Name and surname | Designation |
|---|---|
| Bheki Ntshangase | HV Plant: Senior Manager |
| Thinus du Plessis | HV Plant: Chief Engineer |

# 5. Revisions

| Date | Rev | Compiler | Remarks |
|---|---|---|---|
| Sept 2017 | 2 | NQ Khumalo | Document number changed from DSP 34-210 to 240-56030406.<br>1: Introduction revised to cover the wires business and Generation requirements.<br>3.3c: Additional requirement for working instruction.<br>3.5c and 3.5d: Additional requirement for a switch-fuse.<br>3.6e: Additional requirement for circuit breaker protection relay.<br>3.7: Additional requirements for plant status and health.<br>3.9c and 3.9d: Additional requirement for cable termination enclosures.<br>3.10: Additional note for the VT for the auxiliary power supply for tele-control equipment.<br>3.12: Additional requirement for VDS.<br>3.16: The requirements for the mounting holes have changed from Ø18 mm to Ø24 mm. |
| March 2010 | 1 | RA Kelly | Specification revised and updated following the inclusion of Eskom's requirements in NRS 006 / SANS 1874 Edition 2.<br>Latest TESCOD template used.<br>Normative references updated.<br>The range of the cable support clamp (in accordance with NRS 012 and D-DT-8019) fitted in each cable termination enclosure shall be<br>in the case of XLPE-insulated cables and 22 kV paper-insulated cables, suitable for an outer cable diameter of 75 – 100 mm.<br>in the case of 11 kV paper-insulated cables, suitable for an outer cable diameter of 50 - 75 mm, |
| March 2010 | 1 | RA Kelly | Where low-voltage ring-type current transformers are required, they shall be positioned so that the minimum distance from the bushing centre line to any part of the highest positioned current transformer is at least 370 mm.<br>The 370 mm dimension is based upon a termination that has been made with a screen cut positioned 200 mm from the end of the cable core insulation (as now specified for "extended screen" indoor terminations in accordance with DSP 34-1622). The additional 170 mm is required for the torque-shear lug (120 mm) and NRS 012 clearance from the top of the CT to the screen cut (50 mm). |

| Date | Rev | Compiler | Remarks |
|---|---|---|---|
| March 2010 | 1 | RA Kelly | The outdoor ring main unit kiosk shall be provided<br>With diagonally slotted holes suitable for M16 holding-down set screws.<br>**Note:** Slotted holes are required to in order to make provision for manufacturing tolerances in the concrete plinth holding down positions.<br>Added Figure 1. |
| Dec 2006 | 1 | RA Kelly | Document reference changed from SCSSCABC0 to 34-210.<br>Complete document revision in accordance with draft NRS 006 (2006). Document updated to reference all new SANS / IEC specifications (SANS / IEC 62271 series).<br>Requirements for indoor RMUs added.<br>Outdoor kiosk requirements revised / added.<br>Revised internal arc classification (IAC) type test requirements added.<br>33kV RMU option added.<br>630A circuit breaker tee-off added.<br>Cable test facilities revised to include interlocking access control.<br>Protection relay requirements added/revised.<br>Optional remote hand-held push-button control (pendant control) requirements added.<br>Optional load monitoring facilities for tee-offs added.<br>Provisions (indications, controls and alarms) and for telecontrol (SCADA) and distribution automation (DA) added.<br>Technical schedules revised and improved. |

## 6. Development team

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

- Thinus du Plessis — HV Plant: Chief Engineer
- Queeneth Khumalo — HV Plant: Chief Engineer
- Peter Almeida — SI GOU: Senior Advisor
- George Daniel — SI GOU: Engineer
- Barto Olivier — SI WCOU: Senior Technician
- Taelo Phali — SI FOU: Senior Technician
- Nivashin Naidoo — O&M KZN OU: Engineer
- Dyke Monyane — Gx Plant Engineering: Chief Technologist
- David Ntombela — DBOUS

## 7. Acknowledgements

The author acknowledges the team which developed the previous revision of the specification.

## Annex A –

| | | | | | |
|---|---|---|---|---|---|
| | **TECHNICAL SCHEDULES A & B FOR 240-56030406** | | | | |
| | **RING MAIN UNITS FOR SYSTEMS WITH NOMINAL VOLTAGES FROM 3.3 KV TO 33 KV** | | | | |
| | **SHORT DESCRIPTION: GENERIC RMU TECHNICAL SCHEDULE** | | | | |
| | **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 | $kV_{rms}$ | 3.3, 6.6, 11, 22 or 33 | _____ |
| 1.2 | SANS 1874 4.2.1 | Rated power-frequency voltage | $kV_{rms}$ | 12, 24 or 36 | _____ |
| 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 | 240-56030406 3.2 & SANS 1874 table 1 | Rated lightning impulse withstand voltage | $kV_{peak}$ | 95, 125 or 170 | _____ |
| 1.7 | SANS 1874 4.2.3 | Rated short-duration power frequency withstand voltage [50Hz: 1 min] | $kV_{rms}$ | 28, 50 or 70 | _____ |
| 1.8 | SANS 1874 4.7.1 | Rated normal current of busbars | A | 630 or 1250 | _____ |

| | | | | | |
|---|---|---|---|---|---|
| 1.9 | SANS 1874 4.4.1.3 | Rated normal current of switch dis-connector | 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** | | | |
| 2.2 | SANS 1874 4.18 | Irrespective of the inland or coastal rating the RMU 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 | 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 |
| 2.6 | 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 | IAC required for the RMUs (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)? | Y / N | N | xxxxxxxx |
| 3.5 | SANS 1874 4.4.2.2 / 4.9.2 | Details of remote opening and closing offered | | N/A | _____ |
| 3.6 | SANS 1874 4.4.2.2 / 4.9.2 | Provision for remote indications and alarms required (i.e. via RTU)? | Y / N | N | xxxxxxxx |
| 3.7 | SANS 1874 4.6.2.18 | Provision for hand-held remote control unit (open, close and earth) required? | | Yes | _____ |
| 3.8 | 240-56030406 3.4b) and 3.25a) | Type of plug-in connector to be supplied | | | _____ |

| | | | | | |
|---|---|---|---|---|---|
| 3.9 | 240-56030406 | Pins for trip control function | | C and D | _____ |
| 3.10 | 240-56030406 | Pins for close control function | | A and B | _____ |
| 3.11 | 240-56030406 3.25 | Details of provisions offered for hand-held remote control unit | 24V/110V | Yes | _____ |
| 3.12 | SANS 1874 4.9.1.4 | Accuracy class and burden (VA) of CT offered (if applicable) | | N/A | xxxxxxxx |
| 3.13 | SANS 1874 4.9.1.6 / 4.9.2 | Provision for communication with an RTU (i.e. remote analogue indication)? | | No | xxxxxxxx |
| 3.14 | 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 | 240-56030406 3.13 | Spacing between bushing centres (min) | mm | 105 mm or<br>90 mm | _____ |
| 4.2 | 240-56030406 3.13 | Spacing between outer bushing centres and enclosure side wall (min) | mm | 55 mm or<br>50 mm | _____ |
| 4.3 | SANS 1874 4.8 | Distance from bushing centre line to cable support clamp (min).<br>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 | 240-56030406 3.13 g) | Size (range) of cable support clamp (3 Core Cable applications) | mm | 50-100 | _____ |
| 4.9 | 240-56030406 3.13 g) | 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 | 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 | 240-56030406 3.4 | Provision for hand-held remote control unit (trip and close) required? | Y/N | Yes | _____ |
| 5.8 | 240-56030406 3.4 b) | Type of plug-in connector to be supplied | | ITT Cannon type CA 3102 A 14S-2 or equivalent | _____ |
| 5.9 | | Pins for trip control function | | C and D | _____ |

| | | | | | |
|---|---|---|---|---|---|
| 5.10 | | Pins for close control function | | A and B | _____ |
| 5.11 | 240-56030406 3.4 | Details of provisions offered for hand-held remote control unit | 24V/110V | xxxxxxxx | _____ |
| 5.12 | 240-56030406 3.10 b) | Second Trip Coil required and Voltage | Y/N<br>V | No<br>_____ | xxxxxxxx<br>xxxxxxxx |
| | | Protection relay Requirements | | | |
| 5.12 | 240-56030406 3.6.1 | Self-Powered Protection Relay (SPR) required. | Y/ N | Y | xxxxxxxx |
| 5.12.1 | 240-56030406 3.6 | Protection functional requirements satisfied, i.e. functions, setting ranges, characteristic curves etc. (provide technical manual). | | xxxxxxxx | _____ |
| 5.12.2 | 240-56030406 3.6.1.1 c) | Details of provisions made to ensure minimum earth fault pick-up current of 40 A. | | xxxxxxxx | _____ |
| 5.12.3 | 240-56030406 3.6 & 3.6.1.3 | CT ratio required if different to that specified (SPR). | A | _____ | xxxxxxxx |
| 5.14 | 240-56030406 3.6.1.3 | Protection CT: type, class and ratio | T_ C_ R | xxxxxxxx | _____ |
| 5.15 | 240-56030406 3.6 & 3.6.1.2 a) | Detail the supply requirements to power up SPR for single and Three Phase conditions | A | xxxxxxxx | _____ |
| 5.16 | 240-56030406 3.6.2 | SPR to include additional functionality for communication of Analogues to IRTU | Y/N | N | xxxxxxxx |
| | | | | | |
| | | Protection IED required for IRTU application. | Y/N | N | _____ |
| | 240-56030406 3.6, 3.6.3.1-3.6.3.12 | Protection functional requirements satisfied, i.e. functions, setting ranges, characteristic curves etc. (provide technical manual). | | xxxxxxxx | _____ |
| | 240-56030406 3.7 | Current sensors- type, class and ratio | T_ C_ R_ | xxxxxxxx | _____ |

| | | | | | |
|---|---|---|---|---|---|
| | 240-56030406 3.8 | Voltage sensors- type, class | T_ C_ | xxxxxxxx | _____ |
| | | | | | |
| **6** | **SANS 1874 4.8** | **Cable termination enclosure of the circuit breaker functional units** | | | |
| 6.1 | 240-56030406 3.13d)/ ,e)/ & f) | Spacing between bushing centres (min) | mm | 90 | _____ |
| 6.2 | 240-56030406 3.13d)/ ,e)/ & f) | 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).<br>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 | _____ |
| 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 / 240-56062752 | _____ |
| 6.8 | 240-56030406 3.13g) | Size (range) of cable support clamp (3 Core Cable applications) | mm | 50-100 | N/A |

| | | | | | |
|---|---|---|---|---|---|
| 6.9 | 240-56030406 3.13 g) | 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** | | **IRTU** | | | |
| 8.1 | SANS 1874 4.9.2 | RTU to be provided? | Y/N | No | xxxxxxxx |
| 8.2 | SANS 1874 4.9.2.1 | Provision for remote status indications and alarms required? | Y/N | No | xxxxxxxx |
| 8.3 | SANS 1874 4.9.2.1 | Local indications to be provided? | Y/N | No | xxxxxxxx |
| 8.4 | SANS 1874 4.9.2.3 | D.C. voltage? | 110V/24V | N/A | _____ |
| 8.5 | 240-56030406 3.12 a) | External LV supply for RTU? | | 230V AC | xxxxxxxx |
| 8.6 | 240-56030406 3.12 b) | Dual Phase VT required for LV Auxiliary power supply (in addition to external LV Power supply) | Y/N | No | xxxxxxxx |
| | 240-56030406 3.12 b) | Details of Dual Phase VT – VA and Voltage Factor | VA & VF | xxxxxxx | _____ |
| | 240-56030406 3.9 b) | Battery supply specified minimum discharge voltage | V | xxxxxxx | _____ |
| | 240-56030406 3.9 | Minimum battery capacity after 4 years | % | >80 | xxxxxxxx |
| | 240-56030406 3.9 | 100% depth of discharge cycles over 4 years | cycles | >200 | 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 & 240-56030406 3.13 | Type of gas indication device | | Density meter | _____ |
| 9.3 | SANS 1874 4.10.5 | Mass of gas: | | | _____ |
| 9.3 | SANS 1874 4.10.5<br>SANS 1874 4.10.6 | a) Busbar chamber | kg | Xxxxxxxx | _____ |
| | | b) Other | kg | Xxxxxxxx | _____ |
| | | Service offered for replenishment and recovery of gas | | Xxxxxxxx | _____ |
| **10**<br>10.1 | **SANS 1874 4.11** | **Earthing** | | | _____ |
| | SANS 1874 4.11.1 | Earth fault level and duration | kA-s | 2 kA – 3 s | _____ |
| **11**<br>11.1 | | **Live circuit indication** | | | _____ |
| | SANS 1874 4.12.4 240-56030406 3.14 | Type of live circuit indication required | | VDS | _____ |
| **12** | **SANS 1874 4.13** | **Earth fault indication** | | | |
| 12.1 | SANS 1874 4.13.1 | Type of earth fault indicator | | Self- Powered via internal CT | _____ |
| 12.2 | SANS 1874 4.13.1<br>SANS 1874 4.13.6 | Earth fault indicator details: | | | _____ |
| | | a) Cable box location for CT | | LHS ‘R’ | _____ |
| 12.3 | SANS 1874 4.13.7 | b) Position of ‘remote’ indicator | | Visible from outside, front of Mini-sub | _____ |
| 12.4 | SANS 1874 4.13.7 | c) Method of protecting indicator against vandalism | | Welded steel tube | _____ |
| 12.5 | SANS 1874 4.13 | Make of earth fault indicator | | Xxxxxxxx | _____ |
| 12.6 | SANS 1874 4.13 | Type (model) of earth fault indicator | | Xxxxxxxx | _____ |

| | | | | | |
|---|---|---|---|---|---|
| **13** | **SANS 1874 4.17** | **Rating plate** | | | _____ |
| 13.1 | SANS 1874 4.17.1 | Method of attaching rating plate | | Xxxxxxxx | _____ |
| **14** | **SANS 1874 4.18** | **Marking and labelling** | | | |
| 14.1 | SANS 1874 4.18.1.1 | Method of attaching labels | | Xxxxxxxx | _____ |
| 14.2 | SANS 1874 4.18.2.1 | Method of fixing and removal of main circuit designation labels for engraving purposes | | Xxxxxxxx | _____ |
| 14.3 | SANS 1874 4.18.4.4 | Mimic indication system required? | Y/N | Yes | xxxxxxxx |
| 14.4 | SANS 1874 4.18.4.4 | Description of mimic indication system | | Xxxxxxxx | _____ |
| 14.5 | | | | | |
| 14.6 | SANS 1874 4.18 & 240-56030406 3.19 | Corrosion protection | | | |
| 14.7 | SANS 1874 4.18 & 240-56030406 3.19 | Application with regard to corrosion protection i.e. inland or coastal | | Coastal | _____ |
| 14.8 | SANS 1874 4.18.9 | Type of material offered: | | | |
| 14.9 | SANS 1874 4.18.9 | a) Ring main unit gas enclosure | | Xxxxxxxx | _____ |
| | | b) Cable termination enclosures and frame | | Xxxxxxxx | _____ |
| | | c) Operating mechanisms | | Xxxxxxxx | _____ |
| **15** | | **Testing** | | | |
| 15.1 | SANS 1874 5.1.3 | Origin of RMU design | | Xxxxxxxx | _____ |

| | | | | | |
|---|---|---|---|---|---|
| 15.2<br>15.3<br>15.4<br>15.5 | SANS 1874 5.1.3 | Origin of Vacuum Interrupter design | | Xxxxxxxx | _____ |
| | | Origin of CT design | | Xxxxxxxx | _____ |
| | | Origin of VT design | | Xxxxxxxx | _____ |
| | | Origin of IRTU design | | Item specific | _____ |
| | | Place of RMU manufacturer | | Xxxxxxxx | _____ |
| 15.6<br>15.1<br>15.2<br>15.3 | SANS 1874 5.1.3 | Place of Vacuum Interrupter manufacturer | | Xxxxxxxx | _____ |
| | | Place of CT manufacturer | | Xxxxxxxx | _____ |
| | | Place of VT manufacturer | | Xxxxxxxx | _____ |
| | | Place of IRTU manufacturer | | Item specific | _____ |
| | | 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 | 240-56030406 3.21 and 3.22 | RMU type test reports and videos | | Yes | xxxxxxxx |
| | 240-56030406 3.6.4 e) | CT type test reports | | Yes | xxxxxxxx |
| | 240-56030406 3.6.5 f) | VT type test reports | | Yes | xxxxxxxx |
| | 240-64685228 4. | SPR Type test report | | Yes | xxxxxxxx |
| | 240-64685228 4. | Protection IED Type test report | | Yes | 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? | | Yes | _____ |
| 17.10 | SANS 1874 7.2 | Copy of CT and VT factory routine test certificate? | Y/N | Yes | _____ |
| 17.11 | SANS 1874 7.2 | Copies of the latest technical catalogue(s) including SPR and 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 |

# Annex B – Impact assessment

Impact assessment form to be completed for all documents.

## 1) Guidelines

- Indicate actions to be taken, persons or organisations responsible for actions and deadline for action.
- Technical Change Implementation Forum (TCIF) to discuss the impact assessment, and if necessary give feedback to the compiler of any omissions or errors.

## 2) Critical points

**2.1 Importance of this document. E.g. is implementation required due to safety deficiencies, statutory requirements, technology changes, document revisions, improved service quality, improved service performance, optimised costs.**

Comment: Document has been revised in accordance with SANS 1874 with minor technical additions – as highlighted in the revision history table. All of Eskom's industry-common requirements in 240-56030406 Rev 1 are now included in SANS 1874 and therefore duplicated clauses have all been removed. Only the Eskom-specific requirements remain in 240-56030406 Rev 1.

**2.2 If the document to be released impacts on statutory or legal compliance - this need to be very clearly stated and so highlighted.**

Comment: N/A – no impact on statutory or legal compliance.

**2.3 Impact on stock holding and depletion of existing stock prior to switch over.**

Comment: None.

**2.4 When will new stock be available?**

Comment: When there is a new national contract in place.

**2.5 Has the interchangeability of the product or item been verified - i.e. when it fails is a straight swop possible with a competitor's product?**

Comment: No. No interchangeability should be allowed.

**2.6 Identify and provide details of other critical (items required for the successful implementation of this document) points to be considered in the implementation of this document.**

Comment: None.

**2.7 Provide details of any comments made by the OUs and Grids regarding the implementation of this document.**

Comment: None

## 3) Implementation timeframe

**3.1 Time period for implementation of requirements.**

Comment: Immediate.

**3.2 Deadline for changeover to new item and personnel to be informed of Dx wide change-over.**

Comment: N/A – no new items created.

## 4) Buyers Guide and Power Office

**4.1 Does the Buyers Guide or Buyers List need updating?**

Comment: No.

**4.2 What Buyer's Guides or items have been created?**

Comment: None.

**4.3 List all assembly drawing changes that have been revised in conjunction with this document.**

Comment: None.

**4.4 If the implementation of this document requires assessment by CAP, provide details under 5**

Comment: None.

**4.5 Which Power Office packages have been created, modified or removed?**

Comment: None. All packages remain the same.

## 5) CAP / LAP Pre-Qualification Process related impacts

**5.1 Is an ad-hoc re-evaluation of all currently accepted suppliers required as a result of implementation of this document?**

Comment: No.

**5.2 If NO, provide motivation for issuing this specification before Acceptance Cycle Expiry date.**

Comment: This standard is revised due to the SCOT process. DSP 34-210 expired in March 2015 thus it was due for revision.

**5.3 Are ALL suppliers (currently accepted per LAP), aware of the nature of changes contained in this document?**

Comment: Yes – The existing suppliers were evaluated based on the requirements as stated in DSP 34-210.

**5.4 Is implementation of the provisions of this document required during the current supplier qualification period?**

Comment: No

**5.5 If Yes to 5.4, what date has been set for all currently accepted suppliers to comply fully?**

Comment: N/A

**5.6 If Yes to 5.4, have all currently accepted suppliers been sent a prior formal notification informing them of Eskom's expectations, including the implementation date deadline?**

Comment: N/A

**5.7 Can the changes made, potentially impact upon the purchase price of the material/equipment?**

Comment: NA

**5.8 Material group(s) affected by specification: (Refer to Pre-Qualification invitation schedule for list of material groups)**

Comment: Free-standing ring main units

## 6) Training or communication

**6.1 Is training required?**

Comment: NO (If NO then 6.2 – 6.6 will be N/A)

**6.2 State the level of training required to implement this document. (E.g. awareness training, practical / on job, module, etc.)**

Comment: N/A

**6.3 State designations of personnel that will require training.**

Comment: N/A.

**6.4 Is the training material available? Identify person responsible for the development of training material.**

Comment: N/A.

**6.5 If applicable, provide details of training that will take place. (e.g. sponsor costs, trainer, schedule of training, course material availability, training in erection / use of new equipment, maintenance training, etc).**

Comment: N/A.

**6.6 Was Technical Training Section consulted w.r.t module development process?**

Comment: N/A.

**6.7 State communication channels to be used to inform target audience.**

Comment: Technical Change Implementation Forum (TCIF)

## 7) Special tools, equipment, software

**7.1 What special tools, equipment, software, etc will need to be purchased by the OUs or Grids to effectively implement?**

Comment: None.

**7.2 Are there stock numbers available for the new equipment?**

Comment: No new SAP numbers created.

**7.3 What will be the costs of these special tools, equipment, software?**

Comment: N/A.

## 8) Finances

**8.1 What total costs would the OUs or Grids be required to incur in implementing this document? Identify all cost activities associated with implementation, e.g. labour, training, tooling, stock, obsolescence.**

Comment: None

……

……

Impact assessment completed by:

Name: Queeneth Khumalo

Designation: PDE HV Plant: Chief Engineer