Eskom	Standard	Technology

Title: **STANDARD MINIMUM REQUIREMENTS FOR THE METERING OF ELECTRICAL ENERGY AND DEMAND**

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1. Introduction

SANS 474/NRS 057 – Code of practice for electricity metering was included in the Metering Grid code and licence requirements for Eskom, and Eskom needs to adhere to the requirements for metering installations as specified.

This document specifies the minimum requirements for electricity metering within Eskom for billing purposes as well as statistical purposes.

2. Supporting clauses

2.1 Scope

2.1.1 Purpose

This standard covers the minimum accuracy and configuration requirements for metering of active and reactive energy and the registration of active and apparent demand in all metering installations in Eskom and includes the metering of domestic supplies.

2.1.2 Applicability

This document shall apply throughout Eskom Holdings Limited Divisions on all of Eskom's metering and measurements installations and statistical metering installations.

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] SANS474/NRS057, Code of practice for electricity metering

[3] 240-76628289, Standard for single and three phase energy meters: whole current single rate

[4] 240-70427065, Standard for single phase programmable energy meters

[5] 240-52840736, Standard for three phase programmable energy meters

[6] SANS 61869-1/IEC 61869-1 Instrument transformers Part 1: General requirements

[7] SANS 61869-2/IEC 61869-2 Instrument transformers Part 2: Additional requirements for current transformers

[8] SANS 61869-3/ IEC 61869-3 Instrument transformers Part 3: Additional requirements for inductive voltage transformers

[9] SANS 61869-4/ IEC 61869-4 Instrument transformers Part 4: Additional requirements for combined transformers

[10] SANS 61869-5/ IEC 61869-5 Instrument transformers Part 5: Additional requirements for capacitive voltage transformers

2.2.2 Informative

None

2.3 Definitions

2.3.1 General

Definition	Description
Accuracy class	A designation assigned to an instrument transformer, the current or voltage error and phase displacement of which remain within specified limits under prescribed conditions of use.
Accuracy class index	A number that gives the limits of the permissible percentage error as defined in the applicable specification for a meter when the meter is tested under reference conditions. **Note:** Multi-range and multi-purpose instruments may have more than one accuracy class index.
Active energy meter (watt-hour meter)	An instrument intended to measure active energy by integrating active power with respect to time. For metering purposes, the unit for active energy is kWh. **Note:** For sinusoidal quantities in a two-wire circuit, it is the product of the voltage, the current, and the cosine of the phase angle between them. For non-sinusoidal quantities it is the sum of the harmonic components, determined as above. In a polyphase circuit it is the sum of the active powers of the individual phases.
Apparent power	The square root of the sum of the squares of the active and reactive powers, measured and calculated in kVA, for sinusoidal quantities in either single phase or polyphase circuits. **Note:** This is, in general, not true for non-sinusoidal quantities.
Arithmetic simultaneous demand	The simultaneous demand obtained by addition of the magnitudes of the kW or kVA values for one group of delivery points for each integrating period
Benefit of diversity:	The operation of totalization and the possible flattening of the load curve have an inherent benefit to the customers maximum demand charge. Where a customer has more than one point of delivery, the benefit of diversity may be granted. Thus the need arises to summate the demands of the different points of supply for each integrating period.
Generation metering	Generation Metering is broadly classified as metering installed within power stations.
Grid metering	Grid Metering is broadly classified as metering installed at the interface boundaries between the Transmission Grid and Generation, Distribution, International Tie-lines and IPPs.
Main and check	This refers to a dedicated metering system with two active and reactive energy meters fed from two dedicated current instrument transformer (CT) cores and one dedicated voltage instrument transformer (VT) winding
Main metering	A dedicated metering system with one active and reactive energy meter. This meter is fed from one dedicated current instrument transformer core and one dedicated voltage instrument transformer winding.
Maximum demand	The average value of power (active or apparent) over a specified interval of time. Demand can be based either on active or apparent demand, depending on the tariff in use. Maximum demand is relevant only on tariffs that have a demand component. The maximum demand is the highest value of demand that occurred during a billing period.

Definition	Description
Point of delivery	A point of delivery consist of one or more points of measurement from where energy is transferred/supplied, emanating from one substation at the same voltage level. Example: If a customer is supplied through four 22kV feeders from the same substation, then this will be accepted as one point of delivery. If a customer is supplied through four 22kV feeders from four different substations, then four points of delivery exist for the customer. If a customer is supplied from the same substation with two 22kV feeders and two 132kV feeders, the two 22kV feeders will be accepted as one point of delivery and the two 132kV feeders will be accepted as a second point of delivery.
Point of measurement (metering point)	A point where energy transfer is measured per each individual feeder. **Note 1:** Each point can have kWh (import and export) and kvarh (Q1, Q2, Q3 & Q4). **Note 2:** The metering equipment shall preferably be installed at the point of supply.
Point of supply	The point at which electricity is supplied to any premises by a supplier
Reactive energy meter (var-hour meter)	An instrument intended to measure reactive energy by integrating reactive power with respect to time. For metering purposes, the unit for reactive energy is kvarh
Three-phase four-wire meter (3P4W)	The 3P4W meter is also referred to as a three element meter, having three current coils to measure line current (red, white and blue phase) and three voltage coils measuring phase to neutral voltages (red to neutral, white to neutral and blue to neutral). This meter can be used for metering three phase wye (Y or star) and delta connected loads, balanced or unbalanced
Three-phase three-wire meter (3P3W)	The 3P3W meter is also referred to as a two element meter, having two current coils to measure line current (red and blue phase) and two voltage coils measuring phase to phase voltages (red to white and blue to white). This meter is primarily used for metering delta connected loads, these being without a neutral conductor
Time of use (TOU)	Tariff structure where energy or demand is measured in defined periods of the day and rates are different for those time periods. Tariffs include Nightsave, Miniflex, Ruraflex and Megaflex.
Vectorial simultaneous demand	The sum of demands for a group for supply points, calculated according to the following formulae: $\text{kVA} = \sqrt{\left(\sum \text{kW}\right)^2 + \left(\sum \text{kvar}\right)^2}$, and $\text{kW} = \sum \text{kW}$, where the sum of kW and kvar is for one group of supply points for each integrating period

2.3.2 Disclosure classification

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

2.4 Abbreviations

Abbreviation	Description
CT	Current Instrument Transformer
Dx	Distribution
GM	General Manager
Gx	Generation
HV	High Voltage
kvar	Kilovar
kW	Kilowatt
LV	Low voltage
n/a	not applicable
POD	Point of Delivery
POM	Point of Measurement
Tx	Transmission
VA	Volt-ampere
VT	Voltage Instrument Transformer

2.5 Roles and responsibilities

The relevant design sections within Eskom Distribution, Transmission and Generation are responsible to implement these requirements according to this document.

2.6 Process for monitoring

Adherence to this document is to be monitored through routine inspections of metering installations.

2.7 Related/supporting documents

This document replaces 240-56364444 revision 1.

3. Requirements

3.1 Exclusions

a) This standard has no bearing on the specific tariffs used at any interface point, and does not describe the functional specification used for particular metering devices of the required accuracy class and configuration.

b) Older installations may not adhere to the requirements as listed in the following paragraphs, but shall as a minimum adhere to the relevant requirements as listed in SANS 474/NRS 057.

3.2 Meters

a) Single phase whole current meters shall comply with 240-76628289, Standard for single and three phase energy meters: whole current single rate.

b) Single phase whole current programmable meters shall comply with 240-70427065, Standard for single phase programmable energy meters

c) Three phase whole current meters shall comply with 240-76628289, Standard for single and three phase energy meters: whole current single rate

d) Three phase programmable meters shall comply with 240-52840736, Standard for three phase programmable energy meters .

3.3 Instrument transformers

All instrument transformers (CTs and VTs) shall comply with the relevant standards as specified in table 1.

Table 1: Instrument transformer standards

Item	Applicable standard:
Current transformers (CT)	SANS 61869-2 and SANS 61869-1
Voltage transformers (VT)	SANS 61869-3 and SANS 61869-1
Combined transformers (CTVT)	SANS 61869-4 and SANS 61869-1
Capacitive Voltage transformer (CVT)	SANS 61869-5 and SANS 61869-1

3.3.1 Current Instrument Transformers

a) The total burden on CT secondary circuitry shall not exceed the rated burden of the CT.

b) CT ratios shall be selected to optimize the CT operation range, within limits of the expected connected load.

Note: The connected ratio shall not be higher than twice the calculated current requirement for the installed NMD (where possible).

3.3.2 Voltage Instrument Transformers

a) VTs shall have one dedicated metering core for metering and/or measurements purposes (where applicable).

b) Where more than one set of VTs are utilised, a voltage selection relay scheme shall be installed.

c) The volt drop across the VT cables shall not contribute to the overall measurement error by more than the accuracy class of the installed meter. Volt drop limits are summarised in table 2 below.

Table 2: Voltage drop limits

Class of Energy Meters	Voltage Drop Limit (Phase to Neutral voltage 63.5V)
0.2S	127 mV (0.2%)
0.5S	318 mV (0.5%)

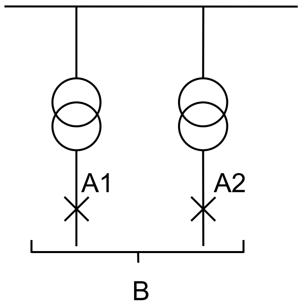
d) The total burden on the VTs secondary circuit shall not exceed the rated burden on the VT.

3.4 Minimum metering accuracy class

a) The accuracy class requirements for each point of measurement (POM) consisting of meter(s) and associated instrument transformers are determined by the nominal size of the load, expressed in terms of apparent power.

b) Table 3 indicates the minimum requirements for metering and instrument transformer accuracy class levels.

c) These accuracy class requirements will be applicable to a point of measurement (POM) and not necessarily to a point of delivery (POD).



‘A’ indicates POMs
‘B’ indicates a POD

Figure 1: Metering POM and POD

Table 3: Minimum requirements for metering and instrument transformers accuracy class levels

		Size of load			
	Whole current ≤ 100kVA	**75 kVA to 1 MVA**	**≥ 1 MVA to < 50 MVA**	**50 MVA and above**	**Statistical metering**
Active energy meter class	1(2)[1]	1	0,5S	0,2S	0,5S
Reactive energy meter class	2	2	1	0,5S	1
Current transformer class	-	0,5	0,2 (0,5) [2]	0,2[3]	0,2[4]
Voltage transformer class	-	0.5	0,2	0,2	0,2[4]

Note 1: Class 2 is acceptable for single phase supplies and prepayment meters.

Note 2: Class 0,5 is acceptable at the lowest ratio of a multi-ratio current instrument transformer.

Note 3: Class 0,2S is preferred for supplies with varying loading conditions.

Note 4: Class 0,5 is acceptable for loads lower than 1MVA.

d) Where the size of the load exceeds 100MVA at the point of delivery (POD), then metering shall be installed on all the points of measurement (POMs) as defined in the 50 MVA column in table 3.

3.5 Metering arrangement

a) Metering equipment shall be installed in Eskom’s own designated substation yards, control rooms and panels.

b) Eskom shall as a general rule not make use of customer CTs and/or VTs to supply their own metering circuits.

Note: The requirements for CTs and VTs at IPP sites may be different and are specified in the relevant IPP standards.

Table 4: Minimum requirements for metering equipment for the various sizes of loads

	Size of load					
	Whole current	**75kVA to 1MVA (LV)**	**100kVA to 1MVA (MV or HV)**	**> 1MVA to 10MVA**	**10MVA and above**	**Statistical metering**
Main	✓	✓	✓	✓	✓	✓
Check				✓[1]	✓	
3P4W[3]	✓	✓	✓	✓	✓	✓
1A			✓	✓	✓	✓
5A		✓	✓[2]	✓[2]	✓[2]	✓[2]

Note 1: Separate CT cores shall be used for check meters (Except on transformer indoor switchgear and CT/VT units where there is a physical space constraint for separate CT cores)

Note 2: The practice of using 5A energy meters on 110V systems was discontinued as from 1995. However, for retrofitting 5A energy meters may still be used.

Note 3: The practice of using 3P3W energy meters was discontinued as from 1994. However, for retrofitting 3P3W energy meters may still be used.

3.6 Apparent demand calculation on multiple PODs

a) Benefit of diversity may be granted to a customer who has multiple points of measurement.

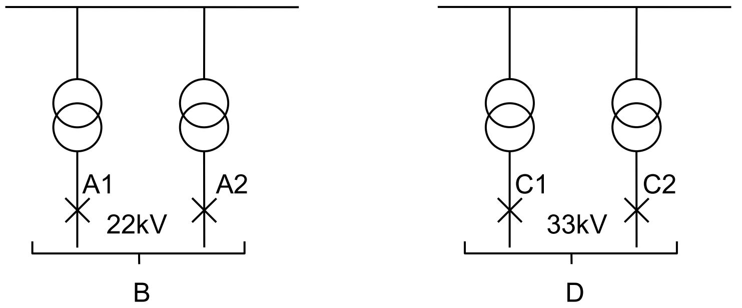


Figure 2: Metering POM and POD demand calculation

b) The kVA demands for the PODs 'B' and 'D' are calculated vectorially and the total demand is calculated arithmetically.

$$Demand\ B = \sqrt{(kW(A1) + kW(A2))^2 + (kvar(A1) + kvar(A2))^2}\ ,\ and$$

$$Demand\ D = \sqrt{(kW(C1) + kW(C2))^2 + (kvar(C1) + kvar(C2))^2}\ ,\ and$$

$$Total\ Demand = Demand\ B + Demand\ D$$

3.7 Remote communication

a) Generation, Grid, TOU and statistical metering points are to be equipped with communications equipment facilitating the remote acquisition of load profile metering data, for billing, settlement and planning purposes.

b) The frequency of meter reading shall not be less than what is stipulated in SANS474 / NRS057.

Table 5: Periodic meter reading intervals

Load	Meter reading interval
> 100 MVA	Daily
10 MVA to < 100 MVA	Weekly
1 MVA to < 10 MVA	Monthly
100 kVA to < 1 MVA	Monthly
< 100 kVA	Three monthly

3.8 Statistical metering

Statistical metering shall be installed at the following points:

a) All breakers feeding out of an MV (11, 22 and 33 kV) or HV (66, 88, 132, 275, 400, 765 kV) bus bar (taking into account point e) below.

b) The MV side of a transformer feeding the above MV bus bar, as an energy balancing check.

c) At least one side of all interconnected feeders.

d) All electrification projects/schemes where more than 300 customers are supplied or where technical requirements for such metering exist (see Annex A).

e) Statistical metering need not be installed where tariff metering are installed which complies with the requirements listed in this document.

3.9 Implementation

Implementation of this standard applies to new and refurbished metering points.

4. Authorization

This document has been seen and accepted by:

Name and surname	Designation
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5. Revisions

Date	Rev.	Compiled By:	Clause	Remarks
Jan 2019	2	HPD Groenewald	Normative references	Reference documents numbering changed to new SANS and Eskom 240… numbers.
			3.3	Added new references to SANS standards for CTs and VTs
			3.3.1	Added note for the requirements for CT ratio
			3.3.2.a	Modified statement.
			3.7.b	Added requirements for frequency of remote downloading of data.
Jun 2013	1	H P D Groenewald	All	Combined the requirements of Distribution, Transmission and Generation.
Nov 2010	1	H P D Groenewald		Development team expanded. Par 3.1 Amended definition of point of measurement to include varh measurement in all four quadrants Table 1 Changed accuracy requirements for active energy

Date	Rev.	Compiled By:	Clause	Remarks
				for loads between 1 and 50mVA to class 0.5S.
Dec 2007	0	H P D Groenewald		This revision cancels and replaces revision no 3 of specification no ESKASAAL6 and revision 2 of DISSCAAY2 Foreword, Development team, Keywords, Introduction added Par 3.1.12 Changed definition to reflect current interpretation Par 3.1.13 Changed definition to reflect current interpretation Par 4.2 Changed references to new numbers Par 4.3 Added a descriptive diagram for POD and POM. Table 1: Changed accuracy class on active energy to 0.2S for > 50MVA points Par 4.4 Table 2: Separate CT cores are mandatory for POM > 1MVA. Removed any references to recorders (discontinued) Par 4.6 Installation of remote communication media is mandatory for all LPU and statistical metering points. Par 5 This standard applies to new and refurbished points Added Annex A: Flow diagram for deciding on statistical metering

6. Development team

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

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- Johan le Roux — PTM
- Sello Lekalakala — PDE SI Limpopo Operating Unit

7. Acknowledgements

Not applicable.

Annex A – Flow Diagram in support of paragraph 3.8

(informative)

PROCESS TO DETERMINE BULK METERING REQUIREMENTS FOR PREPAID PROJECTS