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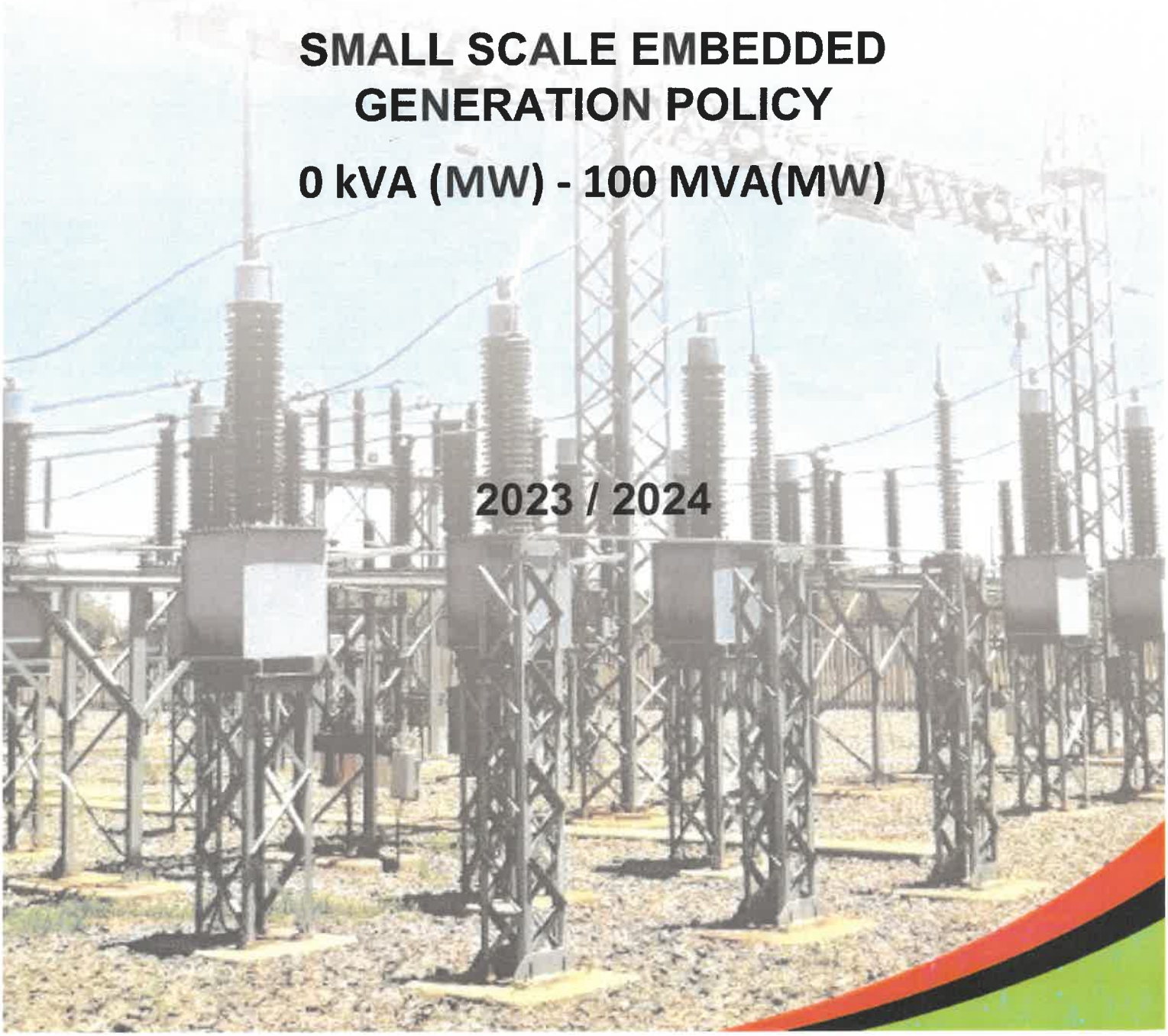
AT THE HEART OF IT ALL

CENTLEC
Reg No: 2003/011612/30

SMALL SCALE EMBEDDED GENERATION POLICY

0 kVA (MW) - 100 MVA(MW)



2023 / 2024

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CENTLEC (SOC) LTD	
Subject: Small Scale Embedded Generation Policy	Policy No: SSEG - Rev 03
Directorate: Engineering Wires	Last Date Of Review: **2022-2023**
Sub-Directorate: Planning	Date Approved: **31 May 2023**
Custodian: GM: Planning	Effective Date: **1 July 2023**

1. EXECUTIVE SUMMARY

The purpose of this policy is to define the process pertaining CENTLEC's requirements and application process for installation, connecting and maintaining all forms of small-scale sustainable embedded generation such as photovoltaic panels to the electricity network, including both renewable and non-renewable energy within CENTLEC area of supply.

The approval process for a small-scale embedded generation (SSEG) installations varies, depending on the size of the system and customer category.

This policy applies to systems with a generation capacity smaller than 100 MVA (100 000 kVA), and all SSEG applicants up to this limit are required to comply with the conditions and process described herein.

This document does not apply to those who wish to install a system with generation capacity of greater than 100MVA (100000 kVA). For such systems a separate meeting should be arranged with CENTLEC (SOC) Ltd in order to establish the necessary requirements and application process.

Customers requiring to connect more than 100MVA will not be able to connect under the conditions of this policy. In addition, a generating license or exemption letter from NERSA will be required before connection is considered.

2. ABBREVIATIONS

Term	Description
AC	Alternating Current
ARC	Auto Reclose
ADMD	After Diversity Maximum Demand
AMI	Advanced Metering Infrastructure
CB	Circuit-Breaker
CT	Current Transformer
DC or dc	Direct Current
ECSA	Engineering Council of South Africa
EG	Embedded Generator
HV	High Voltage
kVA	kilovolt-ampere
kW	kilowatt

kWp	kilowatt peak
LV	Low Voltage
MV	Medium Voltage
MVA	Mega Volt-Ampere
NEC/R	Neutral Earthing Compensator with Resistor
NERSA	National Energy Regulator of South Africa
PCC	Point of Common Coupling
PGC	Point of Generator Connection
pu	per unit
PUC	Point of Utility Connection
PV	Photovoltaic
QOS	QOS: Quality of Supply
RPP	Renewable Power Plant
SCADA	Supervisory Control and Data Acquisition
SSP	Secure Supply Point
SEF	Sensitive Earth Fault
SSEG	Small Scale Embedded Generation
ROCOF	Rate of Change of Frequency (protection)

RTU	Remote Terminal Unit
VAT	Value Added Tax
VT	Voltage Transformer

3. DEFINITIONS

Term	Description
Distributor	CENTLEC Distribution and any public electricity supply utility (e.g. CENTLEC, Municipality) that might adopt this standard.
DNP3 (Distributed Network Protocol)	(Distributed Network Protocol) is the preferred communications protocol used for the control of electricity on transmission and distribution networks as per NRS 037-1.
Embedded Generator's authorized person	The person appointed by the Embedded Generator in terms of the appropriate act to sanction the return to service of plant after major maintenance or repair.
Embedded Generator's responsible person	The person appointed by the Embedded Generator in terms of the appropriate act to receive communications and take necessary action in accordance with instructions from the system controller.
Embedded Generator	A legal entity that operates or desires to operate a generating plant that is or will be connected to the Distribution network. This definition includes all types of connected generation, including co-generators and renewables. Alternatively, the item of generating plant that is or will be connected to the Distribution network.
High voltage	The set of nominal voltage levels greater than 44 000V and up to and including 220 000V. [SANS 1019]
Island	A portion of the utility's distribution network energized solely by one or more Embedded Generators.

Loss-of-grid protection	Relay protection designed to detect the loss of connection to the utility network and trip the Embedded Generator to prevent it from energizing an island.
Low voltage	Nominal voltage levels up to and including 1kV. [SANS 1019]
Medium voltage	The set of nominal voltage levels greater than 1 000V and up to and including 44 000V. [SANS 1019]
Point of Common Coupling (PCC):	The electrical node on the Distributor's network, electrically nearest to a particular Embedded Generator's installation, at which more than one customer is or may be connected or metered.
Point of Utility Connection (PUC):	The circuit-breaker and associated ancillary equipment (instrument transformers, protection, isolators) that connects the Embedded Generator facility to the Distribution network. The PUC forms the point of demarcation between the assets of the Distributor, and those of the Embedded Generator.
Reverse power flow	The flow of energy from the customer electricity installation onto the utility grid (i.e. export) as a result of the instantaneous generation exceeding the instantaneous consumption at the generation site in question.
Secure Supply Point (SSP)	That point on the Distributor's network at which a single upstream contingency will not result in the islanding of an Embedded Generator with a portion of the supply network.

Shared Network	A section of the utility grid that supplies more than one customer.
Small-scale embedded generator	A small-scale embedded generator for the purposes of these Requirements is an embedded generator with a generation capacity of less than 100 000kVA (100MVA)
Stand-by generator	A legal entity that operates or desires to operate a generating plant so as to provide a stand-by supply in the event of a loss of the grid electricity supply. The stand- by generator's plant will only be connected to the Distribution network for maintenance load testing, and only if the requirements of this standard have been fulfilled.

4. NORMATIVE REFERENCES

Parties using this standard shall apply the most recent edition of the documents listed below:

South African Legislation:

- Electricity Regulation Act 6 of 2006.
- Occupational Health and Safety Act No 85 of 1993.
- South African Distribution Code (all parts).
- South African Grid Code (all parts).

International and National Standards:

- IEC 62271-100: High-voltage alternating-current circuit-breakers.

- IEEE 1547.1, IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Resources with Electric Power Systems.
- NRS 029, Current transformers for rated a.c. voltages from 3,6kV up to and including 420kV.
- NRS 030, Electricity distribution – Inductive voltage transformers for rated a.c. voltages from 3,6kV up to and including 145kV for indoor and outdoor applications.
- NRS 031, Alternating current disconnectors and earthing switches (above 1000V).
- NRS 037-1, Telecontrol Protocol for stand-alone remote terminal units.
- NRS 048-2, Electricity Supply – Quality of Supply Part 2: Voltage characteristics, compatibility levels, limits and assessment methods.
- NRS 048-4, Electricity Supply – Quality of Supply Part 4: Application guidelines for utilities.
- NRS 054, Rationalized User Specification – Power Transformers.
- NRS 057-4, Electricity metering Part 4: Code of practice
- NRS 097-2-1 part 2, Grid interconnection of embedded generation, small scale embedded generation.
- NRS 097-2-3 part 2, Grid interconnection of embedded generation, small scale embedded generation, simplified utility connection criteria for low-voltage connected generators.
- SANS 1019, Standard voltages, currents and insulation levels for electricity supply.
- International and National Standards (Protective Relays):
- IEC 60068-2-1, Environmental testing — Part 1 Cold.
- IEC 60068-2-2, Environmental testing — Part 2 Dry Heat.
- IEC 60068-2-30, Environmental testing — Part 30 Damp heat, cyclic (12h + 12h cycle).
- IEC 60255-30, Electrical relays Part 3: Single input energizing quantity measuring relays with dependent and independent time.
- IEC 60255-6, Electrical relays Part 6: Measuring relays and protection equipment.
- IEC 60255-21, Electrical relays Part 21 Vibration, shock, bump and seismic tests on measuring relays and protection equipment (All sections).
- When downloaded from the EDS database, this document is uncontrolled and the responsibility rests with the user

5. REQUIREMENTS

SSEG Installation commissioning confirmation;

Type verification test sheets for SSEG installation and protection or lock out systems installed (to be part of SSEG interface):

Copy of Certificate of Compliance in terms of OHS Act Electrical Installation Regulations;

Declaration by professional technologist/engineer registered with ECSA or another professional Institution for the installation of embedded generation.

NERSA requires municipalities to register and maintain a database of all SSEG installations in its area. Clients shall provide the Information below as a minimum:

- The technology of the generation
- The capacity of the installation
- Its location both on the network and GPS co-ordinates
- The capacity of energy storage if installed
- The customer name and account number

In the event that there is reverse power flow into the Municipal grid, a suitable meter shall be installed at the cost of the customer for the measurement of energy fed back into the Municipal Grid from the customer's consumption.

5.1 Open access to networks for safe operation

An Embedded Generator (EG) may connect to the CENTLEC network at any time provided safety can be assured. EGs are required to operate within legal power quality limits. The EG shall be held liable for deviations from legal power quality limits that CENTLEC customers may experience as a result of the EG's equipment. Therefore, no EG shall continue to energize any portion of the Distribution network that has been unintentionally or intentionally interrupted on a section of the Distributor's network. Disconnection compliant with NRS standards shall occur at the PUC upon detection of an unintentional or intentional power interruption. The primary concern is for human safety, plant protection and power quality, in that order.

The CENTLEC System Operator and/or Control Centre reserves the sole right to permit the operation of intentional islands within the CENTLEC Distribution network. EGs permitted to operate intentional islands shall adhere to the procedures and operating requirements as stipulated by the System Operator and/or Control Centre.

The EG shall be responsible for protecting his/her own assets. Notwithstanding this, unnecessary tripping of EGs presents quality of supply and network stability problems and should be avoided where possible. Safe operation of the distribution network, power system stability and security of supply are paramount and require that the Distributor be responsible for specifying predetermined minimum protection, measurements and SCADA requirements to the EG.

Where it is necessary for CENTLEC to provide any electrical lines, or other electrical plant, or for any other works to be carried out to enable the connection of embedded generation to its networks, CENTLEC may require payments in respect of any expenditure incurred in carrying out this work

5.2 Ownership

This standard does not stipulate the specific ownership of plant used at the PUC. The only exceptions are the CENTLEC metering equipment, remote terminal units and communications infrastructure. These will be CENTLEC owned, operated and maintained.

Specifics regarding the ownership of other plant, including the instrument transformers, must be agreed between the participants. Nevertheless, the following ownership regimes are preferred:

- The EG owns, operates and maintains the PUC circuit-breaker. Specifically, the EG shall own the circuit-breaker and associated instrument transformers and protection and the isolator to be installed between the PUC circuit-breaker and the Distributor's network. The specific point of demarcation between the utility and the EG shall be the Distributor-side terminals of the isolator. The clamps or cable terminations made at this point shall be the responsibility of the Distributor.

OR

- The Distributor owns, operates and maintains the PUC equipment. Specifically, the Distributor shall own the circuit-breaker and associated instrument transformers and protection and the isolator to be installed between the PUC circuit-breaker and the EG's facility. The specific point of demarcation between the utility and the EG shall be the EG-side terminals of the isolator. The clamps or cable terminations made at this point shall be the responsibility of the EG. Each party shall be responsible for the commissioning, operation and maintenance of plant installed on their side of the PUC. The CENTLEC-owned metering equipment, remote terminal units and infrastructure will be commissioned, operated and maintained by CENTLEC irrespective of its specific location.

6 AUTONOMY

Each party is to design, protect and maintain their own assets to industry best practice. The PUC represents the point of demarcation, and is a point of common interest. The standard provides minimum technical requirements for the equipment and functionality to be provided at the PUC. The PGC provides back-up to the protection functions of the PUC, and is also subject to minimum technical requirements imposed by the Distributor (CENTLEC).

All of the required PUC functionality shall be provided at the PUC or in exceptional circumstances at an alternate location agreeable to both parties. All of the required functionality shall be provided at the same location. Any changes to the PUC or PGC will be agreed between the parties prior to implementation.

7 EMBEDDED GENERATION APPLICATION PROCESS

Embedded Generation application must be done in writing by means of completing an official application form, which is obtainable from the Customer Care offices at the Power Station building in Fort Street. No consideration shall be given to any application if it is not received in writing. The application. All applications for systems larger than 350 kVA, a grid impact studies will be required.

8 LEGAL REQUIREMENTS

The Electricity Regulation Act 6 of 2006 details the legislative requirements with regard to the generation, transmission, distribution and trading of electricity. In this regard, the operator of a grid-connected generator is required to hold a license from the Regulator (Section 8). Operators of non-grid connected generators are not required to hold a license provided that the plant is designated only for own-use, and is not used commercially (Schedule II).

Section 47 (1) of the Act makes provision for the Regulator to, following consultation with licensees and other participants, set guidelines and publish codes of conduct and practice. The South African Grid Code and Distribution Code are examples of such codes of practice.

The South African Distribution Code includes a section of specific requirements for the connection of EG's. Under Section 8.2 (4) of the South African Distribution Code: Network Code, each South African Distributor is required to develop a protection requirement guide for the connection of EG's. This standard serves to fulfil CENTLEC Distribution's obligation in this regard.

Each EG installation must be designed to comply with the Grid Code, Distribution Code and CENTLEC requirements detailed in this standard.

9 OPERATIONAL SAFETY

9.1 Operational and safety aspects

The EG must obtain from the relevant Distributor a written agreement to operate generating equipment in parallel with the Distributor's network. A plant diagram and schedule giving details of ownership, operation, maintenance and control of substation and generation plant shall be prepared, as agreed between the parties. The schedule shall include:

- Names and contact details of responsible persons from both parties.

- A description of any operating limitations with regard to the plant and/or the interconnection.

The EG shall ensure that all operating personnel are competent in that they have adequate knowledge and sound judgment to take the correct action when dealing with an emergency. Failure to take correct action may jeopardize the EG's and/or CENTLEC's systems.

EG shall ensure:

- Except in the case of agreed unmanned facilities, that a responsible person is available at all times to receive communications from CENTLEC's system controller so that emergencies requiring urgent action by the EG can be dealt with adequately. Where required by CENTLEC, it will also be a duty of the EG's staff to advise the CENTLEC system controller immediately of any abnormalities that occur on the Embedded Generating plant which have caused, or might cause, disturbance to the CENTLEC system;
- That where it is necessary for his employees to operate CENTLEC equipment (where provided), they have been designated in writing by CENTLEC as an "authorized person" for this purpose. All operations on the CENTLEC equipment must be carried out to the specific instructions of the CENTLEC system controller. In an emergency, a switch can be opened by anybody, without prior agreement in order to avoid danger. The operation must be reported to the CENTLEC system controller immediately afterwards.

10 SYNCHRONIZATION

All Embedded Generating plant other than mains excited asynchronous machines must be synchronized with the CENTLEC supply prior to making the parallel connection. The voltage between the unit and the system prior to synchronizing shall not differ by more than the values specified in Table 1. Where the mode of operation of generating equipment is such that synchronizing of a machine or machines will occur at intervals of less than two hours, the voltage fluctuation at the PGC resulting from the generation capacity being connected shall not exceed 1 %.

Automatic synchronizing equipment shall be the preferred method of synchronizing. However, manual synchronization of the EG units is permissible on condition that synchronizing check relays (three phase comparators) are used by the EG in conjunction with the manual synchronizing, and that the EG's responsible person is authorized in writing to do so.

It is the responsibility of the EG to provide synchronizing facilities. Typical limits for synchronizing parameters are given in Table 1 below

Aggregate rating of EG (kVA)	Maximum Frequency Difference (Hz)	Maximum Voltage Difference (%)	Maximum Phase Angle Difference (Degrees)
S < 500	0.3	10	20
500 ≤ S < 1500	0.2	5	15
S ≥ 1500	0.1	3	10

Table 1. Typical synchronizing parameter limits (IEEE 1547 p.12)

11 REQUIREMENTS FOR THE UTILITY NETWORK INTERFACE

11.1 Fault Infeed

When it is proposed to install Embedded Generating plant, consideration must be given to the contribution that the plant will make to the fault levels on the

Distributor's network. The design and safe operation of the EG's and Distributor's installations depend upon accurate assessment of the fault contributions made by all plant operating in parallel at the instant of the fault. The EG shall discuss this with the relevant Distributor at the earliest possible stage. The EG shall provide all relevant information for the Distributor to be able to model the generator and its contribution to fault current.

Should the EG result in the increase of fault levels to such an extent that the Distributor's or customer's plant at the PCC is placed at risk, the EG shall apply fault current limiting measures to ensure that the fault levels are maintained at acceptable levels. The fault limiting solution applied shall be presented to the Distributor for acceptance prior to implementation.

12 QUALITY OF SUPPLY

Voltage quality parameters, i.e. voltage regulation, unbalance, flicker and harmonic distortion, at the PCC and other customer points of supply, may not exceed the compatibility levels or limits as prescribed in NRS 048-2 and Distribution Standard 34-542 due to operation of the EG. The rapid rate of voltage change limits, as set out in NRS 048-4, shall also not be exceeded by the EG.

13 NEUTRAL EARTHING

This policy stipulates the neutral earthing philosophy (refer to CENTLEC standards) to be applied on EG networks that are galvanized and/or copper tinted and connected to the CENTLEC supply network. Adequate earthing of networks at other voltage levels within the EG plant is the responsibility of the EG, and is not stipulated herein.

The Distributor's networks may use effective, resistive or reactive earthing methods depending on the voltage level and local requirements. The magnitude of the possible earth fault current will depend on which of these methods is used. The EG's earthing arrangement must therefore be designed as follows:

- In consultation with the Distributor such that the EG's system is compatible with the Distributor's system.
- Such that the EG's plant safety is not compromised due to the above requirement.

14 GENERAL PROTECTION REQUIREMENTS

All protection relays used at the PUC and PGC shall comply with the type test requirements of Annexure C.

- b)Protection relay accuracy requirements of the following sections shall be defined as per IEC60255- 3 and -6.
- c)Except where the PUC and PGC are the same point, the PUC and PGC protection shall be totally independent of each other.
- d)Protection clearance times and coordination shall comply with the requirements specified as a result of the EG integration fault studies.
- e)If automatic resetting of the protective equipment is used (e.g. for an unmanned EG facility), the time delays must applied in consultation with the regional auto-reclose philosophy. The automatic reset must be inhibited for faults within the EG installation.
- f)Each protection relay system shall include a sequence of event recording function that logs any settings change; settings group change, protection pick-up or trip operation, or change in circuit- breaker and/or input and output status.
- g)The relay system installed at the PUC shall incorporate an oscillographic waveform recording function capable of storing at least five 15-cycle recordings at a sampling rate of 16 samples per cycle or higher. The waveform recording shall contain the three phase voltage, three phase current and neutral current signals from the PUC as well as all significant digital signals (i.e. protection tripping elements, circuit-breaker status, input and output contact status etc.). A recording shall be triggered upon any protection operation.

15 OVERCURRENT, EARTH FAULT AND SENSITIVE EARTH FAULT PROTECTION

Overcurrent and earth fault protection shall provide Inverse Definite Minimum Time (IDMT) time-current characteristics. IDMT curves shall be in accordance with the requirements of IEC-60255-3: Type A, B and C curves (i.e. IEC Normal Inverse, Very Inverse and Extremely Inverse).

Overcurrent protection will be provided in all cases. Voltage-controlled overcurrent protection shall be considered in applications where the fault current contribution of EG decays with time. Appropriate Earth Fault protection will be applied in all cases. Current-based detection is not appropriate in MV networks where the generator or generator transformer does not include a point of neutral earthing.

Sensitive Earth Fault protection will be applied on MV networks where the generator or generator transformer provides a point of neutral earthing to the CENTLEC network. SEF protection will be set in compliance with Distribution Standard 34-540. Sensitive Earth Fault protection will use a Definite Time characteristic. The overcurrent, earth fault and SEF protection shall be set to coordinate with the CENTLEC network protection as dictated by the integration fault studies.

16 METERING

The metering arrangement adopted per EG application will depend on the specific conditions of the power purchase agreement. The following metering philosophy shall, however, apply to all EG interconnections:

- Tariff metering and billing shall be done by the Distributor using 4 quadrant meters.

  Note: In certain cases, CENTLEC will be both a buyer and a seller of the EG's electrical power output (from the same location).

- Tariff meters for the sale of electrical energy to CENTLEC will be located such that they measure the net energy exported by the EG, excluding the power consumed by its auxiliaries.
- All CENTLEC-owned meters shall include facilities for automated remote downloading by CENTLEC. The meters shall be available for communication at any time.

- A meter and modem shall be installed, owned and maintained by CENTLEC (SOC) LTD. Uploaded metering data will be made available to the client on the CENTLEC (SOC) LTD metering web site. Data charges may be recovered through an Administration charge.

16.1 Cost of the Metering Equipment

The customer will be required to pay full cost of the metering equipment plus programming, installation and admin costs.

16.2 Billing, Administration and other Charges

Green energy generated will be considered on a monthly basis and the energy traded (generated and imported) will be for all hours of the month. As there is a cast to provide, maintain and administer the electrical network, the NERSA guidelines allow a monthly fixed service charge to cover network and administration charges, as well as an energy charge.

The approved tariff for net-metering will be applicable for the relevant financial year.

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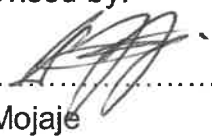
Revised by:



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J Mojaje

EM: Engineering Wires

Supported by:

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Acting EM: Engineering Retail

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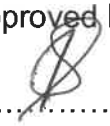

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M Sekoboto

Chief Executive Officer

17 ANNEXURE

Below are the categories applicable to this (CENTLEC SSEG) policy:

Category A: 0 – 1MVA (Only LV connected RPPs): This category includes RPPs with rated power of less than 1 MVA and connected to the LV voltage (typically called 'small or micro turbines'). This category shall further be divided into 3 sub-categories:

Category A1: 0 – 13,8kVA: This sub-category includes RPPs of Category A with rated power in the range of 0 to 13,8kVA.

Category A2: 13,8kVA – 100kVA: This sub-category includes RPPs of Category A with rated power in the range greater than 13,8kVA but less than 100kVA.

Category A3: 100kVA – 1MVA: This sub-category includes RPPs of Category A with rated power in the range 100kVA but less than 1MVA. This category also includes RPPs of Category A1 and A2 with a rated power less than 100kVA that are directly connected to a MV-LV transformer.

Note: RPPs with a rated power greater than 4,6kVA must be a balanced three-phase.