REQUIREMENTS FOR SMALL-SCALE EMBEDDED GENERATION

Conditions and application process to become an embedded generator in the City of Matlosana Municipality

February 2020

Contents

Disclaimer and Indemnity

The information contained in this document is for information purposes only and to guide stakeholders regarding the requirements and application process of the City of Matlosana Municipality in connecting embedded generation to the municipal electricity network. The opinions expressed are in good faith and while every care has been taken in preparing this document, and the authors make no representations and give no warranties of whatever nature in respect of these documents, including but not limited to the accuracy or completeness of any information, facts and/or opinions contained therein.

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AMEU Working Group on standardised SSEG documentation:

Johannesburg – City Power	Tshwane	eThekwini	Nelson Mandela Bay Metropolitan Municipality	Buffalo City	Mangaung - Centlec	Cape Town	Ekurhuleni

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i. Information on this document

Purpose of the document

The purpose of this document is to guide stakeholders regarding the requirements and application process of the Municipality in connecting all forms of embedded generation to the municipal electricity network.

The need for this document

The parallel connection of any generator to the municipal electrical network, however powered, has numerous implications for the local Municipality. It shall therefore be regulated and managed. This document serves to:

- Ensure the safety of the municipal staff, the public and the user of the SSEG installation.
- Uphold the power quality of the municipal electricity network
- Clarify metering and billing requirements and options
- Balance municipal revenue impact to enable continued operation of all municipal functions

In addition, municipalities are faced with low carbon development imperatives and economic growth challenges. SSEG can play a role in both of these areas, and the document therefore also serves to:

- Promote the development of the SSEG industry by creating a conducive environment for growth.

Scope

This document covers:

- The connection SSEG installations to the municipal electrical network
- Installations up to 1MVA (although different conditions apply above or below 350kVA – see later)
- Installations connected to low voltage networks
- installations where customers remain net consumers (consume more electricity from the grid than they generate on average)

This document does not cover:

- Systems with a generation capacity above 1MVA (anyone wanting to connect a SSEG system greater than 1MVA should engage with the municipality to determine their requirements before commencing with any application).
- Wheeling regulations
- The connection of SSEG to the Eskom electrical grid.
- Systems connecting to MV and HV networks (although the NRS 097-1 standards covering MV and HV connections are not complete, such systems may be approved by the Municipality, but are likely to require grid impact studies and should be discussed separately with the municipality)
- Installations where customers are net generators (generate more than they consume on average)

Defining small scale embedded generation	Small-scale embedded generation (SSEG) refers to power generation installations less than or equal to 1MVA/1000kVA which are located on residential, commercial or industrial sites. SSEG is in contrast to large-scale generation units that generate large amounts of power, typically in the multi-Megawatt range. A SSEG customer generates electricity on the customer's side of the municipal electricity meter, where the generation equipment is connected to, and synchronised with, the municipal electricity network (i.e. 'embedded').
Who this document is for	This document will assist all relevant stakeholders involved in the commissioning, installation, management and ownership of a SSEG system, with generation capacity less than or equal to 1 MVA (1000 kVA), to the municipal electrical network. It is intended to provide guidance in this regard to: • SSEG project developers • Residential and commercial property owners • SSEG installers • Energy consultants commissioned to design SSEG systems • Municipal officials involved in SSEG generation • Registered technical personnel who are involved in SSEG commissioning

ii. Glossary & Definitions

Alternating current	The flow of electrical energy that follows a sine wave and changes direction at a fixed frequency (i.e. it 'alternates'). Most residential and commercial uses of electricity require alternating current.
Direct current	The flow of electrical energy in one constant direction. Direct current is typically converted to alternating current for practical purposes as most modern uses of electricity require alternating current.
Anti-Islanding	The ability of an SSEG installation to instantly and automatically disconnect the SSEG installation from the municipal electrical network whenever there is a power outage in the municipal electrical network, thus preventing the export of electricity to the municipal electrical network from the SSEG installation. This is done primarily to protect municipal electrical network workers who may be working on the electrical network and who may be unaware that the electrical network is still being energized by the SSEG.
Bi-directional meter	A meter that separately measures electricity flow in both directions (import and export)
Customer	In the context of this document, customers who also generate shall be referred to as "customers", although in effect they are generators.
Generating capacity	The maximum amount of electricity, measured in kilovolt Amperes (kVA), which can flow out of the generation equipment into the customer's alternating current wiring system. This is therefore the maximum alternating current power flow which can be generated by the system in its current configuration.
Grid-tied	An SSEG installation that is connected to the municipal electrical network either directly or through a customer's internal wiring is said to be "grid-tied". The export of energy onto the municipal electrical network is possible when generation exceeds consumption at any point in time.
Inverter	A power device that converts direct current to alternating current at a voltage and frequency which enables the SSEG installation to be connected to the municipal electrical network.
Isolated	A section of an municipal electrical network which is disconnected from all other possible sources of electrical potential is said to be isolated
Load profile	The profile or curve showing the variation of the customer's rate of electricity consumption (or demand) over time.

Low-voltage	Voltage levels up to and including 1 kV (1kV= 1000 Volts)
Medium-voltage	Voltage levels greater than 1 kV up to and including 35 kV.
Pr Eng or Pr Tech Eng or Pr Techni Eng	This refers to a professional engineer, professional technologist or professional engineering technician who is registered with the Engineering Council of South Africa (ECSA).
Reverse power flow	The flow of energy from the customer electricity installation onto the municipal electrical network (i.e. export) as a result of the instantaneous generation exceeding the instantaneous consumption at the generation site in question.
SSEG Connection Contract	The terms and conditions governing the connection of the SSEG installation to the municipal electrical network accepted by the customer
Small Scale embedded generator or SSEG	A small-scale embedded generator for the purposes of these guidelines is an embedded generator with a generation capacity of less than or equal to 1000 kVA (1MVA).
Stand-alone generator/ off-grid generator	A generator that is not in any way connected to the municipal electrical network. Export of energy onto the municipal electrical network by the generator is therefore not possible.

iii. Abbreviations

AC	Alternating current
AMI	Advanced Metering Infrastructure
DC	Direct current
ECSA	Engineering Council of South Africa
EG	Embedded Generation/Generator
HV	High Voltage
kVA	kilo-Volt Ampere (unit of apparent electrical power, often similar in magnitude to kW)
kW	kilo-Watt (unit of electrical power)
kWp	kilo-Watt peak (the rated peak output of solar PV panels)
LV	Low Voltage
MV	Medium Voltage
MVA	Mega-Volt Amperes (1000 kVA)
MW	Mega-Watt (1000 kW)
NERSA	National Energy Regulator of South Africa
NMD	Notified Maximum Demand
PV	Photovoltaic
SSEG	Small Scale Embedded Generation/Generator
VAT	Value Added Tax

1. Introduction

Due to increases in the price of electricity from the national grid and a steady decline in the price of decentralised generation options such as solar PV small-scale embedded generation (i.e. 'rooftop' type systems), decentralised generation sources such as SSEGs are becoming financially more attractive in South Africa. Increasingly such systems are being installed by businesses and residences. It is therefore important that approval procedures are established and standards are adhered to by municipal distributors to regularise this fast changing situation.

Municipal distributors are obliged to ensure that distribution grid power quality and safety standards are upheld to protect municipal staff working on the municipal electrical network, to protect the public in general, and to protect municipal infrastructure. Also, the potential revenue impact of accelerating SSEG installations needs to be managed. This requires changes to current tariff structures, in particular residential tariffs.

The above needs to be balanced with municipal obligations to embrace low-carbon energy and green economic growth opportunities, so a user-friendly framework around installation application and approval is important to promote the growth of this sector. Such a framework will also minimise systems being installed without going through official channels, thereby potentially not meeting required safety and quality standards.

Municipalities play a vital role in facilitating the necessary regulatory environment to enable the establishment and growth of the SSEG market. This document outlines the municipal requirements and processes for prospective SSEG installations to connect to the municipal electrical network such that the above factors are balanced.

2. Indemnity, Legal Requirements & Curtailment

2.1. Legal and Illegal Connections to the municipal electrical network

Customers wishing to connect SSEGs legally to the municipal electrical network shall be required to follow the normal application procedure as detailed in this document and comply with the regulations and standards listed herein.

The Municipality's Electricity Supply By-Law (as promulgated) and national regulations state that no electrical generation equipment may be connected to the municipal electrical network without the express consent of the Municipal Electricity Distributor.

Failure to obtain this consent constitutes an offence which could lead to a fine and/or imprisonment. Furthermore, the installation may also be in contravention of the Occupational Health and Safety Act (1993), for which punitive sanctions also apply.

Customers found to have illegally connected an SSEG installation to the municipal electrical network (either before or after their electricity meter) shall be instructed to have the installation disconnected from the municipal electrical network. Should the customer fail to have the SSEG disconnected from the municipal electrical network, the Municipality shall disconnect the electricity supply to the property.

In cases where unauthorised reverse feed-in takes place which results in the meter reversing to the benefit of the customer, the municipality may institute action to recover lost revenue and relevant punitive fines will be applicable.

No exemption from any of the Municipality's requirements shall be granted for "retrospective applications".

2.2. Generation Curtailment

In the event of operating conditions resulting in municipal electrical network parameters not meeting statutory minimum quality-of-supply standards it may become necessary to impose peak generation limits on embedded generator installations. It is expected that these limitations would be of a temporary nature, applied only during abnormal system conditions or low load periods.

2.3. Right to adapt rules & regulations

In the event of provincial or national legislative changes to the regulatory environment, or other technical developments, it may become necessary to implement changes to the municipal requirements which SSEGs are to comply with. The Municipality will take into account the implications for existing customers of such changes, and will require these only where grid safety or other important criteria are potentially compromised. All SSEGs, new and existing, will be obliged to comply with such changes, and will do so at their own cost.

2.4. Right to deny access

Customers wishing to install an SSEG system, regardless of generation capacity, must complete the relevant sections of the application process in full, and written approval to commence must be received from the Municipality before installation of the SSEG commences. The Municipality needs to ensure that, amongst other considerations, the SSEG installation can be accommodated on the municipal electrical network and that the total SSEG capacity of the municipal electrical network has not been exceeded, considering parameters in the NRS097-2-3 and other applicable standards. Equipment should not be purchased prior to obtaining written approval from the Municipality to commence, as approval of the SSEG as proposed by the applicant is not guaranteed and the Municipality shall not be held liable for equipment expenses in such cases.

Where proposed SSEG systems are not approved by the Municipality, the Municipality will provide information to the customer on amendments to the proposed system required, and/or advise on conditions to be met, for it to be acceptable to the Municipality.

2.5. Contract with the municipality

All SSEG customers are required to enter into an SSEG contract with the municipality. The document *General Terms and Conditions: Contract for Connection of an Embedded Generator* is available on the municipal website or from municipal electricity department offices. In signing the SSEG Application Form and submitting it to the municipality, the customer agrees to be bound by the terms and conditions in this document.

2.6. Transfer/change of ownership

If a transfer of the property and/or change of ownership of the electricity accountholder takes place, the new owner needs to sign the declaration in Annex 12, which must be submitted to the electricity department.

Alternatively the SSEG installation shall be decommissioned as set out in paragraph 3.11.

3. General Guidelines - Small Scale Embedded Generators

This section covers important considerations in terms of the Municipality's SSEG rules and regulations that apply to all customers, including residential, commercial and industrial customers, who wish to connect a SSEG system, with a generation capacity no greater than 1 MVA (1000 kVA), to the municipal electrical network.

Anyone wanting to connect systems over 1 MVA shall not be able to connect under the conditions in this document and should approach the municipality directly to discuss the way forward. It is likely that grid impact studies will be necessary in these circumstances, amongst other work. In addition a generating licence issued by NERSA shall be required before connection of systems over 1MVA are considered.

3.1. Registration or Generation licence

In terms of the Electricity Regulation Act (2006), any person that owns or operates a generation facility is required to obtain a generation licence to be issued by NERSA unless otherwise exempt as per Schedule 2 in the Act. In the event that the owner or operator is exempt from the obligation to obtain a generation licence, the person must still register the generation facility according to NERSA requirements (as published).

If a generation licence is required in terms of the Electricity Regulation Act (2006) then it is the customer's responsibility to interact with NERSA to obtain such. The Municipality is obliged to report to NERSA on a regular basis regarding all municipal electrical network connected generation and it is also obliged to disconnect generators that are not adhering to regulations.

3.2. All SSEGs shall be net consumers

All SSEG installations shall consume more energy than they produce over a consecutive 12-month period.

3.3. Applicable technical standards

Most of the technical requirements that SSEGs are required to comply with are covered in the following standards:

1. NRS 097-2 series: Grid interconnection of embedded generation: Part 2 Small Scale Embedded Generators, in particular:
    a. NRS097-2-1: Utility interface
    b. NRS097-2-3: Simplified utility connection criteria for low-voltage connected generators

In addition, SSEG installations are to comply with the following standards, legislation and regulations:

1. South African Renewable Power Plant Grid Code (although the NRS 097-2 series cover most issues relevant to SSEG)
2. NRS 048: Electricity Supply – Quality of Supply
3. SANS 10142-1 and 10142-1-2: The wiring of premises (as amended and published)
4. SANS 474 / NRS 057 : Code of Practice for Electricity Metering
5. Municipal Electricity Supply by-law

3.4. Testing of Inverters

Until such time as a SABS mark is issued for inverters, the Municipality shall require proof in the form of test certificates, of type tests having been successfully carried out by a third party testing authority

certifying compliance of the inverters with NRS097-2-1 (and NRS097-2-2 when published). The use of inverters without such certification is not permitted, both in new and existing installations. The installation of reverse feed blocking does not exempt the customer from providing the NRS097-2-1 certification.

In general, the test certificate must be for the current version of NRS097-2-1. The municipality reserves the right not to accept test certificates for old versions of NRS097-2-1.

The certification body must be SANAS accredited or be recognised by the International Laboratory Accreditation Co-operation (ILAC) or the International Accreditation Forum (IAF) in terms of ISO/IEC 17025:2005 for photovoltaic systems. The accreditation bodies must provide accreditation documentation for the specific test location.

The customer should require the inverter suppliers to provide the necessary certification before the equipment is purchased.

3.5. Islanding / Anti-Islanding installations

All SSEG installations are required to have an anti-islanding function (immediate disconnection when there is a general power outage) as stipulated in the NRS 097-2-1. Certification to this effect is required of inverters (see 3.4 Testing of Inverters).

Should the inverter or SSEG installation have the facility to both comply with the NRS 097-2-1 requirements for grid-connected systems (including anti-islanding requirements) AND operate in "islanded mode" where the SSEG installation supplies power to a portion of the customer's electrical grid during a general power outage, the islanded system shall be effectively isolated from the municipal electrical network during islanded mode operation.

If the SSEG installation is to be configured as a standby supply after isolating from the municipal electrical network (in which case it becomes an 'alternative supply', not an embedded generator any longer) using a break-before-make changeover switch, a registered person in terms of the Electrical Installation Regulations (2009) shall issue a Certificate of Compliance to the owner if the generator is to be connected to the existing internal wiring of the property. Requirements of SANS 10142-1 apply.

3.6. Battery or other Storage

Battery or other storage may be included in the SSEG configuration. Where it is connected in standby power supply mode (i.e. it is not configured to provide power in parallel to the SSEG but only to operate in islanded mode) the provisions for 'island mode' generators in Section 3.5 Islanding / Anti-Islanding installations apply.

Where storage is connected such that it can provide power onto the network, for example through a storage/battery inverter (even only to feed into the customers wiring which is in turn connected to the municipal network), the storage/battery inverter shall be NRS097-2-1 certified, and such a certificate of compliance provided to the municipality.

3.7. Fire safety and emergency shut-off switch

Emergency disconnection switching shall be in accordance with NRS 097-2-1.

3.8. Dead Grid safety Lock

Dead Grid Safety Lock shall be in accordance with SANS10142-1-2 (as published).

3.9. Qualified installers

The municipality recommends that customers installing solar PV SSEG use industry accredited installers under a third party quality assurance such as PV Green Card: A SAPVIA (South African Photovoltaic Industries Association) endorsed programme to ensure the quality and safety of PV installations. www.pvgreencard.co.za. In the future, the municipality will require PV SSEG installers to have a PV Green Card.

3.10. SSEG Sign-off on Commissioning

Until SANS 10142-1-2 '*The wiring of premises; Specific requirements for embedded generation installations connected to the low voltage distribution Network in South Africa*' is published, upon commissioning, all SSEGs shall be signed off as follows:

Up to 30kVA -

(for PV) Industry Accredited Installer* signoff

OR

ECSA registered Pr Eng or Pr Tech Eng

Over 30kVA –

ECSA registered Pr Eng or Pr Tech Eng

Upon the publishing and implementation of the SANS10142-1-2, a registered person in terms of the Electrical Installation Regulations (1993) with appropriate knowledge and experience in applying the SANS10142-1-2 (acceptable to the Municipality) will be adequate to sign-off all SSEGs.

3.11. Decommission of SSEG system

The Municipality requires notice of any SSEG installation which has been decommissioned. The SSEG installation must, at the owners' cost, be disconnected from the municipal electrical network by the removal of the wiring that connects the SSEG with the municipal electrical network and a decommissioning report filed (on the prescribed form) – including the provision of a Certificate of Compliance to confirm disconnection.

3.12. Eskom grid connection

Customers residing within the municipal boundaries, but located in Eskom's area of supply, need to apply to Eskom for consent to connect the SSEG installation to the Eskom electrical grid. The municipality will not be involved in this process.

3.13. SSEG applications from sub-tenants or other non-municipal customers

The municipality will only engage with applications from their existing or new customers. Where an SSEG installation is intended but the person purchases electricity from a re-seller (e.g. landlord/lady), for example, not directly from the municipality, the application will need to come from the re-seller who is a municipal electricity customer.

3.14. Off-grid system

Stand-alone generators (not connected to the municipal electrical network in anyway) do not need permission from the Municipal Electricity authority. However, approvals from other Departments may still be necessary (e.g. Building), and it is the responsibility of the owner to comply with any such requirements.

3.15. Load profile management to maximise benefit to the customer

Customers will generally find it most financially beneficial to ensure that they utilise as much of the generated electricity as they can and avoid or minimise reverse power flow. With solar PV SSEG, for example, with a residential SSEG installation, loads such as geysers and pool pumps could be shifted to the middle of the day when solar generation is typically at its highest – between mid-morning and mid-afternoon.

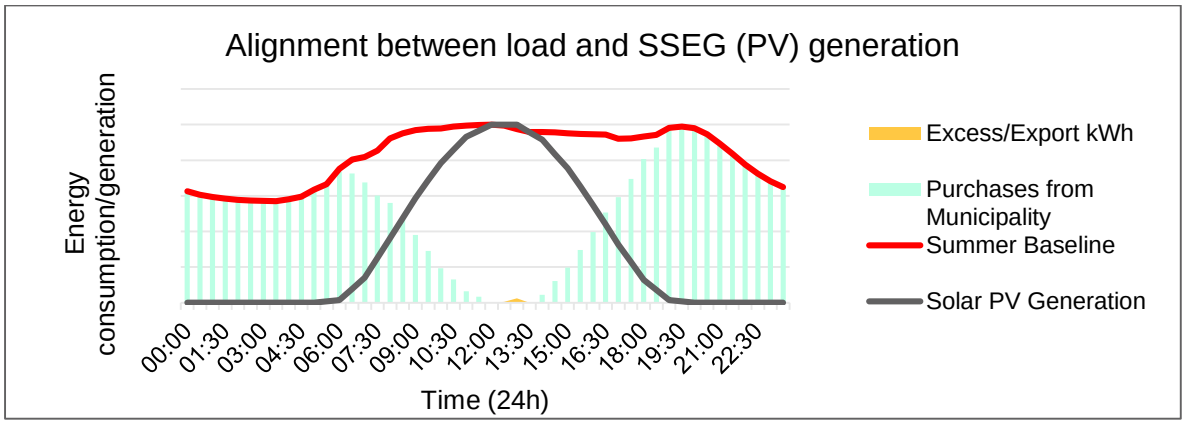

Figure 1: Load profile management - alignment between load profile (red line) and SSEG (PV) generation (grey line).

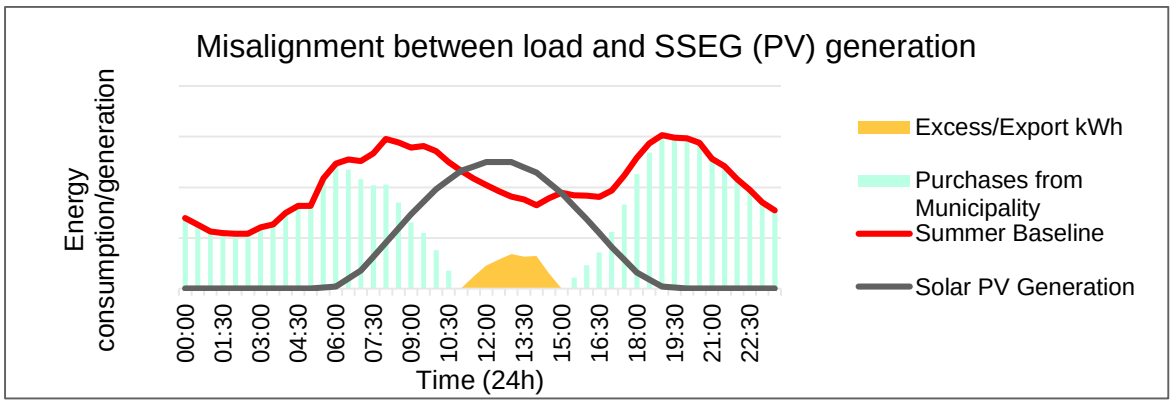

Figure 2: Load profile management - misalignment between load profile (red line) and SSEG (PV) generation (grey line).

4. Metering

4.1. Metering installation and reverse power flow/ feed-in to the municipal electrical network

Customers installing SSEG shall have a bi-directional SSEG meter which is approved by the municipality. Customers should enquire with the municipality regarding suitable meters before purchasing them. The meter will be procured and paid for by the customer.

Until the municipality has a specific SSEG tariff in place which is approved by NERSA, reversed feed will be allowed but will not be compensated for (note that this is a temporary situation pending the operationalising of SSEG tariffs).

Conventional credit or prepayment meters are not allowed to run backwards.

4.2. Adaption of electrical metering installation

The Municipality reserves the right to require customers moving onto an SSEG tariff to adapt their electrical installations in such a way that the metering is located in a kiosk in the road reserve. The municipality will inform prospective SSEG customers accordingly should this be required.

4.3. Refunds of electricity already pre-purchased

Where applicants currently have prepayment meters, these will need to be replaced with meters appropriate for SSEG systems and tariffs. Refund of Prepayment meter (PPM) units when a customer changes to the SSEG tariff and has an appropriate meter installed will not be given. The customer should therefore delay the installation of an SSEG-appropriate meter until the units purchased are used. Otherwise units purchased on the PPM will be forfeited.

5. SSEG connection criteria

Simplified SSEG connection criteria are specified in the NRS 097-2-3, and applications for systems that fall within these parameters are likely to be easily processed by the Municipality, and only in rare cases will require grid impact studies in their assessment. Such parameters include:

- Systems not larger than 350kVA
- Connecting to a LV network

Applications to connect SSEG installations which exceed the parameters of the NRS097-2-3 but do not exceed 1MVA will also be accepted by the Municipality, but may require specialist grid-impact studies in their assessment. The Municipality will advise the customer of such needs after the application form is received.

There are different criteria for simplified connection in shared and dedicated LV feeders, as described below (for details see the relevant sections of the NRS097-2-3):

Note that the below is a summary of parts of the NRS097-2-3 (2014), and is provided for information purposes. The parameters and criteria in the latest version of the NRS097-2-3 may differ from the below and, where this is the case, they supersede the below information. It is therefore important to consult the latest version of the NRS097-2-3 as the criteria therein will be used to assess the SSEG application.

5.1. Shared LV feeders

The NRS 097-2-3 specifies that the maximum individual generation limit in a shared LV feeder (which applies to most small commercial and residential situations) shall not exceed 25% of the consumer's NMD, and be up to a maximum of 20kVA. The following SSEG size limitations are derived from NRS 097-2-3 for Shared LV connections.

Table 1: SSEG size limitations - NRS 097-2-3 for Shared LV connections

Service connection		
No. of Phases	Service Circuit Breaker Size (A) per phase	Maximum Total Generation Capacity of SSEG (kVA)
1	40	2.3
1	60	3.5
1	80	4.6
3	40	6.9
3	60	10.4
3	80	13.8
3	100	17.3

Notes to table:

- To determine if you have a single-phase or three-phase connection, check the main circuit-breaker on the distribution board. A single-phase supply will generally have a single main circuit-breaker, and a three-phase a triple main circuit-breaker. If in doubt consult an electrician.
- 'Maximum total generation capacity' refers to the total output capacity of the generator. For PV systems in particular, this refers to the maximum output of the inverter. Due to system losses this is typically 10 to 20% lower than the maximum output of the PV panels, which is specified in DC kilo-Watt-peak (kWp). The system designer/installer will provide guidance here.

If SSEG generation capacity is 4.6 kVA or less, a single-phase inverter can be installed even if the customer has a three-phase connection. Systems above 4.6 kVA are required to be balanced across the phases.

5.2. Dedicated LV feeders

On dedicated LV feeders the maximum generator size is limited to 75% of the NMD.

5.3. Cumulative SSEG capacity and impact on LV and MV networks

Should the cumulative installed capacity of an SSEG installation be such that it may impact negatively on local LV or MV network functioning, as per the stipulations of NRS097-2-3, the municipality will not allow further SSEG connections until they can be demonstrated to be undertaken without such negative impact. Increasing the SSEG carrying capacity on feeders may require network hardware upgrades. Specialist grid impact studies may be requested of the new SSEG applicant to demonstrate this, even if the system size falls within the NRS097-2-3 parameters.

5.4. Grid impact studies

Should the SSEG being applied for exceed the parameters in the NRS097-2-3 (Simplified Connection Criteria), a Grid Impact Study is likely to be requested by the municipality before the application can be assessed. Content and coverage of such a study may vary depending on the circumstance.[1]

Should such impact studies be required by the municipality, details of method, data and payment requirements should be discussed with the municipality. Responsibilities of the municipality (who has the network data) and the customer in completing the study will also need to be clarified. Even in the case of SSEG with no reverse feed, scenarios such as Load Rejection may still need to be assessed in the study.

[1] Note that studies undertaken in the City of Tshwane indicate that there is considerable capacity on the network for PV SSEG penetration beyond NRS097-2-3 levels without adverse impact, and future revisions of the NRS097-2-3 may extend the scope for PV penetration without impact studies as more information emerges.

Further information on Grid Impact Studies is given in Annex A, and more detailed guidelines can be found in *Recommended practice for assessing the connection of small generators based on renewable energy sources to low-voltage and medium-voltage municipal grids* (Moeller & Poeller Engineering, May 2018 – Final Draft).

6. SSEG Tariffs

The Municipal SSEG tariffs, once approved by NERSA, will be available on the municipal website or from the electricity department offices on request. Tariffs are updated annually. Where SSEG tariffs have not yet been approved by NERSA, reverse feed will be accepted but will not be compensated for.

General information on SSEG tariffs is given below:

6.1. Residential SSEG Tariff

The Residential SSEG tariff structure will be determined at a later stage. The typical SSEG tariff structure consists of the following:

Fixed charge: This comprises (1) a Network charge, which ensures that fixed costs associated with maintaining and operating the municipal electrical network are recovered through appropriate charges, and (2) a Service charge that covers the fixed costs associated with providing a retail service network (metering, billing, customer call centre) are recovered through appropriate service charges.

Energy charge (c/kWh): The variable cost associated with the volume of energy consumed is recovered through appropriate charges. This is billed on a per kWh basis and may be simple (Flat or Inclining Block tariff) or complex (Time of Use or other tariff).

Export (Feed-in) rate (c/kWh): The customer should be compensated for energy provided back onto the network through an export tariff.

6.2. Commercial and Industrial SSEG Tariff

Commercial and industrial customers that are on tariffs which already have a fixed service charge and network demand charge will retain this tariff structure, and an export (feed-in) generation tariff component will be added for reimbursement for energy exported onto the municipal electrical network. Customers on a tariff that does not include fixed service/network charge and demand charge will be changed to an appropriate tariff.

Commercial and Industrial customers should note that the demand charge component of the tariff is unlikely to change after the installation of the SSEG because the monthly maximum demand is unlikely to reduce due to the regular occurrence of cloudy weather.

6.3. Billing Period

The daily service charge along with charges for consumption and credits for feed-in shall be billed monthly (as is done for other Municipal services e.g. water and rates). Any credits from excess SSEG generation in a particular month will be rolled over to the following month. Credits will not be paid out to the customer.

6.4. Connection Costs

The Municipality may stipulate a connection cost to be paid by SSEG customers prior to system generation approval. This will be reflected in the currently applicable tariff schedule.

6.5. Increased Costs

The Municipality bares no responsibility should the customer's electricity bill increase due to changes in the applicable tariff. It is up to the customer to ensure that they understand the financial implications of having an SSEG installation installed and the applicable tariffs.

6.6. Time-of-Use Tariffs

Time of Use tariffs are considered best practice for both consumption and export (feed-in) tariffs, and municipalities may increasingly move to such tariffs over time.

7. Approvals required from other municipal departments

Approvals required of other municipal departments are to be obtained prior to submission of the SSEG application form, and reflected on the form.

7.1. Buildings/Planning department

No building plans are required to be submitted provided the SSEG installation does not project more than 1.5 m, measured perpendicularly, above the roof and/or not more than 600mm above the highest point of the roof. If the above parameters are exceeded then full building plans, including an engineer's endorsement, are required. A relaxation in terms of the Zoning Scheme Regulations may also be required under either one or both of the above circumstances.

Ground-mounted systems: no building plans are required to be submitted provided the panel(s) in its installed position does not project more than 2.1 metres above the natural/finished ground level. Full building plans are required where any part of the installation projects more than 2.1 metres above the ground level.

7.2. Other Approvals

SSEG installations covered by this document do not require Environmental Impact Assessments[2].
For generators that produce noise or air pollutants (e.g. diesel generators), approval from Municipal departments is required (e.g. health, environment).

8. Who pays for what?

The customer is responsible to pay for the following:

- The supply and installation of meters (in accordance with the Municipality's metering policy)
- Connection charges (if applicable)
- Specialist municipal electrical network impact studies - if required (details of payment amounts are to be discussed with the municipality)
- Any changes required to the municipal electrical network upstream of the connection point as a result of the SSEG installation.
- Specialist test that are required, e.g. Inverter testing
- Any other costs associated with obtaining approval for the SSEG connection to the municipal grid

[2] Large-scale embedded generation installations would require environmental authorisation (EA) in terms of the NEMA 2010 EIA Regulations if they generate > 10 MW electricity. In addition the electrical transmission infrastructure that may be associated with a large scale embedded generation system would also require EA if it has a capacity of 275 kV or more within an urban area, or more than 33kV outside urban areas.

9. SSEG application process

The *Application for the Connection of Embedded Generation* form shall be completed for all applications to connect an SSEG installation to the municipal electrical network. The forms are available on the Municipality's website or from the electricity department offices.

- **Step 1: Obtain the Application Form**
  - Visit the Municipality's website and download the relevant application form/s or request the forms from the electricity department offices.
- **Step 2: Complete application form for the connection of SSEG**
  - The Municipality requires that the application form/s be signed by the current property owner.
  - Details of the proposed installer shall also be provided.
  - The applicant may need support from the proposed installer or registered personnel in completing the application form.
  - By signing the application form the customer agrees to the *General Terms and Conditions: Contract for Connection of an Embedded Generator* (this document is available on the municipal website or on request from the electricity department offices).
- **Step 3: Obtain permission from other Municipality departments**
  - The electricity department requires prior approval of the proposed SSEG installation from other departments as stipulated in the form (e.g. buildings department). All such approvals must be reflected in or submitted with the application form.
- **Step 4: Submit completed application form/s and attachments**
  - Form/s shall be submitted to the relevant contacts at the electricity department.
  - Attachments to the application include an initial design circuit diagram (for >100kVA systems) and the inverter certification of compliance with NRS 097-2-1.
- **Step 5: Installation commencement upon approval from the municipality**
  - After due consideration of the application, the applicant will be informed in writing whether the application has been successful or not.
  - If further information or grid studies are required by the municipality, the applicant will be notified thereof.
  - Once notified of a successful application, the applicant may commence installation (it is advised that the applicant does not pay for any equipment until municipal approval to install is granted in writing, as such approval is not guaranteed).
- **Step 6: Commissioning and documentation to be submitted to the electricity department.**
  - Commissioning of the SSEG installation shall be undertaken by a competent person, who shall complete and sign off the *SSEG Installation Commissioning Report*.
  - In addition to the *SEG Installation Commissioning Report*, there is a list of other documentation specified on the Commissioning Report for submission with the Report, including:
    - Final as-built circuit diagram
    - Inverter type test certificate according to NRS 097-2-1.
    - An electrical installation Certificate of Compliance as per SANS 10142-1 (and SANS 10142-1-2 when published).
    - All completed documentation shall be submitted to the relevant electricity department office.

- **Step 7: Inspection of installation if necessary**
  - The Municipality shall inspect the SSEG installation if they deem it necessary, although this is unlikely in the case of a residential application.
- **Step 8: Approval granted to connect to the municipal electrical network and generation commences**
  - If all of the above is satisfactory, the Municipality shall install the necessary meter, or check that such is installed.
  - Approval to connect the SSEG installation to the municipal electrical network shall be provided by the electricity department to the customer, in writing, together with any operation and other requirements deemed necessary.
  - Once this is done, the change to the SSEG tariff shall be implemented if applicable.

10. Changes to existing approved systems

SSEG installations that have previously been approved by the municipality but where changes to the SSEG are planned, will require the following:

A new application shall be completed when the following is intended:

- An expansion in the SSEG capacity
- A change in the SSEG configuration (e.g adding storage with synchronisation capabilities in parallel to the existing EG)

A new commissioning process needs to be undertaken, and a new Commissioning Report completed, when the following changes are made:

- Significant components are replaced (i.e. inverter, anti-island device, dead grid safety lock, other protection equipment) but system capacity is not increased
- A system is moved but no changes to capacity or significant components are made (i.e. inverter, anti-island device, dead grid safety lock, other protection equipment)

11. ANNEX A: Grid Impact Study Overview

In cases where an SSEG application falls outside the simplified connection criteria in NRS097-2-3, it may be necessary to conduct grid impact studies. These studies will assess whether the grid or electrical network remains within prescribed technical limits[3] after the connection of the SSEG. The municipality will provide specific requirements in this regard. Some general information is below.

General grid impact studies

For most SSEG systems connecting to LV networks grid impact studies can be relatively simply undertaken – often with only hand calculations - and do not require detailed grid simulation. They can thus be undertaken by municipalities without such power system simulation software. More detailed

[3] As a minimum these limits should be in line with the South African Grid Code (SAGC), Distribution Code and the SAGC Requirements for Renewable Power Plants

guidelines on assessing such impacts can be found in *Recommended practice for assessing the connection of small generators based on renewable energy sources to low-voltage and medium-voltage municipal grids* (Moeller & Poeller Engineering, May 2018 – Final Draft).

Requirements for more complex Grid Impact Studies

Where more complicated grid impact studies are required, power system simulation may need to be undertaken using appropriate software.

The SSEG application should indicate the generator[4] technology, rating (size) and proposed connection point.

The municipality will be required to utilise their geographic and operational knowledge of the network to determine the areas that could potentially be affected by the SSEG. In order to conduct the studies the municipality will need to have a representative model of the network affected in the format required by the simulation software tool.

As a minimum, the model should contain the following data for the affected network:

- Line and cable parameters (resistance, reactance and capacitance) for the affected network
- Transformer impedances and tap settings for all affected transformers
- Accurate load data for the affected network
- Accurate representation of the impedance and fault contribution of surrounding network(s)
- Parameters of any other equipment installed in the affected network e.g. capacitors and reactors
- Parameters of any other SSEG installed in the affected network
- Any approved planned network changes / upgrades in the affected network

Studies to conduct

The studies as summarised in Table 2 are normally conducted to assess the impact of SSEG connection. In some cases, more detailed studies may be required (e.g. if it is a voltage constrained network, voltage stability studies may be required); however, those are not addressed in this document.

Table 2: Grid impact studies to be conducted

Type of study	Parameters to check
Load flow	Equipment thermal loading within limits Steady state voltages within limits Note any significant changes in power flow direction
Fault level assessment	Ensure that circuit breaker and other protective equipment ratings are not exceeded
Protection co-ordination	Ensure all protection settings are relevant
Power quality assessment	Magnitude of voltage variations due to intermittent generation Harmonics Flicker

[4] A Grid Code Compliant generator should be assumed for purposes of the grid impact studies

It is important to conduct these studies for a number of plausible boundary conditions and ensure that for all scenarios, the network remains within technical limits. As a minimum, these boundary conditions are:-

- Peak load, maximum generation
- Light load[5], maximum generation
- Peak load, minimum generation
- Light load, minimum generation

The ***accuracy*** of the load assumptions is critical in obtaining credible results.

Study outcomes

If the studies show that the SSEG will not have a negative impact on the network, the applicant can be given the go-ahead to connect.

If the studies show that the SSEG could potentially have a negative impact on the network, further studies will be required to determine the scope of the network infrastructure changes / upgrades required to maintain network integrity.

Cumulative impact of SSEG

As penetration levels of SSEG increase, their impact will no longer just be localised.

It is important to take stock every “x” kW or every “y” months to check the cumulative impact of embedded generation in MV and LV networks.

A database of all approved and commissioned connections, as well as the related MV/LV transformer from which they are supplied is key to such a study. A study would then be conducted to assess the overall network integrity with all the SSEG operational under various load and generation scenarios.

Further Information

More detailed guidelines can be found in *Recommended practice for assessing the connection of small generators based on renewable energy sources to low-voltage and medium-voltage municipal grids* (Moeller & Poeller Engineering, May 2018 – Final Draft).

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[5] If the SSEG is PV, the minimum daytime load will be required – not the absolute minimum

12. ANNEX B: New Owner/Account Holder Declaration

In the event of transfer of property and/or ownership, the below Declaration is to be signed by new owner / account holder:

Declaration regarding the SSEG system located at:		
Property Erf number:		
Physical address:		
Township / Suburb / Farm:		Post code:
Site GPS coordinates:	**Latitude (dd mm ss)**	S ° ` ``
	Longitude (dd mm ss)	E ° ` ``
Name of owner/account holder:		
Electricity Account Number:		
Telephone Number:	Land:	Mobile:
Email Address:		

Acceptance of Terms and Conditions

I, the Customer (Account Holder) acknowledge that I have read and understood the General Terms and Conditions: Contract for Connection of Embedded Generator and that by signing this application form, I agree to be bound by the General Terms and Conditions: Contract for Connection of Embedded Generator, should approval for the Embedded Generator be granted by the municipality. A copy of the General Terms and Conditions: Contract for Connection of Embedded Generator can be found on the Municipal website or is obtainable from the electricity department offices on request. Any amended terms and conditions found on the aforementioned website will form part of the terms and conditions of the General Terms and Conditions: Contract for Connection of Embedded Generator, to which terms I, the Customer, agree to be bound. The information provided in the SSEG Application Form accepted by the Municipality also forms part of the General Terms and Conditions: Contract for Connection of Embedded Generator.

Customer (Account Holder) Signoff:

_____ _____ _____

Name Date Signature

The declaration must be submitted to the electricity department.