# Modelling Information for Non-Registered Generators

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Part of Energy Queensland

## Purpose

Certain entities are exempt from the requirement to register with *AEMO* as a *Generator* in order to *connect* an *embedded generating system* to *Ergon Energy's* or *Energex's distribution system*. This means that they are not directly subject to the requirement to provide *Ergon Energy* or *Energex* with modelling information under *AEMO's Power System Model Guidelines*.

However, as *Ergon Energy* and *Energex* have obligations under the *NER* to maintain the security and stability of its *distribution system* and the broader *power system*, it frequently needs certain modelling information in order to assess the effect of connecting the *embedded generating system* to its *distribution network*.

This fact sheet is intended to clarify, for *Non-Registered Distribution Connected Units*, what modelling information may be required to be provided to *us* upon submission of an *Application to Connect*.

## Modelling requirements based on class of generating system

Ergon Energy and Energex's "Standard for High Voltage EG Connections" (document reference STNW1175) classifies *generating systems* into a number of different classes depending on their *nameplate capacity*. Each class also has defined model information requirements, that are to be submitted with the application to connect. This is shown in Table 1 below.

*Table 1 - Modelling Requirements by Class*

| Generation Capacity | Connection Category | Connection Type | Modelling Requirement |
|---|---|---|---|
| ≤ 1.5MVA | Class A1 | Chapter 5A of the *NER* | *PSCAD™/EMTDC™* model generally not required. |
| > 1.5MVA but < 5MVA | Class A2 | Chapter 5A of the *NER* | Site-specific tuned EMT model by the Proponent |
| ≥ 5MVA | Class B | Chapter 5 of the *NER* | Site-specific tuned *PSCAD™/EMTDC™* model required to be provided by the Proponent. |

This Fact Sheet clarifies requirements for Class A2 systems.

# Application to Connect

Generators connecting under Chapter 5A of the NER, submit the final design data at the application stage, detailing:

- system settings, and the reasoning for use of those settings, including the voltage control strategy for the site,
- proposed performance standards,
- final single-line diagrams,
- datasheets and evidence of standards compliance,
- modelling, as detailed below.

Application checklists, containing more detail, are available on our website, and can be found by searching "checklist class A2" at https://www.ergon.com.au or https://www.energex.com.au.

# Requirements for Class A2 Inverter-Based Generating Systems

For a Class A2 inverter-based *generating system*, *you* will need to give *us* a pre-validated and current electromagnetic transient-type simulation model that is compatible with version 5 of *PSCAD™/EMTDC™* and compiled with Intel OneAPI Fortran Compiler: Classic 2021.x (32-bit & 64-bit). Models shall be delivered in a format that allows for maintenance for life of asset. (e.g. .dll, support files).

*You* must also ensure that *we* are given a *releasable user guide* for the *PSCAD™/EMTDC™* model, which should incorporate details on how to use the *PSCAD™/EMTDC™* model. This *releasable user guide* must contain sufficient information to allow entities with no prior knowledge of the particular *distribution connected unit* to perform system studies.

The modelling parameters must be consistent with the *releasable user guide*.

This simulation model must:

a) fully and accurately represent the particular *distribution connected unit*, that is, it must:

   i. be based on data specific to the particular manufacturer, make and model of the *embedded generating system*;

   ii. incorporate *OEM*-specific simulation models where available (which may be black-box encrypted simulation models);

   iii. incorporate the particular auxiliary or supporting electrical equipment (including *instrument transformers* and any power plant controllers) that will be installed (as opposed to generic data or assumptions);

   iv. reflect the particular physical arrangement of the *distribution connected unit* and its connection to our *distribution system*;

v. include the *inverter* and power plant control systems complete with the controller block diagrams (so as to explain the operation of the model without compromising the model veracity); and

vi. include the settings which are to be implemented on site (note that where any conversions are required between the actual *generating system* parameters and those implemented in the model, a mapping table of those conversions should also be provided);

b) be based on (as appropriate), the most recent preliminary design and, once commissioned, include any applicable updates;

c) be capable of reflecting the actual performance of the *distribution connected unit* under all expected or potential operating conditions;

d) be suitable for *us* to assess the impact of connecting the *distribution connected unit* to *our distribution system* at the *connection point* (including, without limitation, relevant security and stability impacts and to prove control system performance at low *distribution system short circuit ratios*), without compromising the veracity of those simulation models; and

e) meet the modelling requirements detailed in *AEMO's Power System Model Guidelines*.

### Certifications

*We* also require *you* and the *OEM* to certify:

a) that the *PSCAD™/EMTDC™* simulation models are valid for the *embedded generating system*;

b) the minimum fault level (synchronous and sub-transient) and *short circuit ratio* at which the *embedded generating system* can reliably operate, and what margins of operation are recommended; and

c) whether the *embedded generating system* is capable of operating down to a minimum *short circuit ratio* of 3.0 at the *connection point*.

## Requirements for Class A2 Rotating Machine Generating Systems

For Class A2 generating systems comprised of rotating machines, detailed control system block diagrams of the relevant control systems are required.

This includes the excitation system, overexcitation limiter (OEL), underexcitation limiter (UEL), automatic voltage regulator (AVR), governor and any site controller, as applicable.

IEEE Std 421.5-2016 provides examples of functional block diagram layout, and the level of detail required.

Stand-by and bumpless systems may be exempted from providing model information.

Note that if the rotating machines is part of the generating system which also includes inverter based generation, then this rotating machine model must be integrated into the *PSCAD™/EMTDC™* model to verify that there are no adverse control system interactions.

## Settings Report

Settings implemented in the generating system's control systems shall be justified with a settings report, based on modelling or manufacturer advice, which details why and how the control settings were determined, thereby allowing the generating system to meets its agreed performance standards.

## Further Information[1]

The following reference documents may provide additional helpful information:

- STNW1175 Standard for High Voltage EG Connections
- Under 5MVA Application Checklist Class A2

Prospective *Non-Registered Embedded Generators* may contact their *Project Sponsor* to obtain further specific information.

## Glossary

Any terms that are used, but not defined, in this Fact Sheet have the meaning given to them in the *NER*.

*AEMO or Australian Energy Market Operator:* The agency responsible for the day to day management of wholesale and retail energy market operations and emergency management protocols for the *NEM*, on-going *NEM* development required to incorporate new rules, infrastructure and participants, and long-term *NEM* planning through demand forecasting data and scenario analysis.

*asynchronous plant* includes asynchronous *generating units* and dynamic *reactive power* support plant that uses phase-locked loops (for example, *static VAR compensators* and *STATCOMs*);

*connection point:* The physical point at which the *embedded generating system* will be *connected* to *Ergon Energy's* or *Energex's distribution system*;

*detailed response* means the relevant "detailed response" (as that term is defined in rule 5.3A.2(a) of the *NER*);

*distribution system:* The distribution system (as that term is defined in the *NER*) owned and operated by *Ergon Energy*.

*distribution connected unit*: a *distribution connected generating unit* or a *distribution connected bidirectional unit,* that is, a generating unit or energy storage unit connected within a distribution system not having direct access to the transmission network.

*Ergon Energy:* In this Fact Sheet, refers to Ergon Energy Corporation Limited as a *Local Network Service Provider*.

*Energex:* In this Fact Sheet, refers to Energex Limited as a *Local Network Service Provider*.

*HiL* means hardware-in-the-loop simulation;

[1] The documents referenced in this section can be found by searching STNW1175, ch
B at https://www.ergon.com.au or https://www.energex.com.au

*inverter* means a device that uses semiconductor devices to transfer power between a direct current (DC) source or load and an alternating current (AC) source or load;

*LNSP or Local Network Service Provider:* A *Network Service Provider* within a local geographical area, which has the relevant jurisdictional authority (such as *Ergon Energy* or *Energex*).

*NEM: National Electricity Market:* The wholesale electricity market operating in relation to the interconnected electricity network in Queensland, NSW, ACT, Tasmania, Victoria and South Australia.

*NER: National Electricity Rules:* The rules under which the *National Electricity Market* operates.

*Network Service Provider:* Has the meaning given to that term in the *NER*.

*OEM* means original equipment manufacturer;

*Power System Model Guidelines:* The guidelines of that name promulgated by *AEMO*;

*Powerlink Queensland* means Queensland Electricity Transmission Corporation Limited ABN 82 078 849 233, being the relevant *Transmission Network Service Provider*;

*Project Sponsor*: An *Ergon Energy* representative who has been allocated to the prospective *Generator* to facilitate the *connection*;

*PSCAD™/EMTDC™* means a software package developed by the Manitoba-HVDC Research Centre that comprises a power systems computer-aided design package which includes an electromagnetic transients (including DC) simulation engine, and which is used to carry out electromagnetic transient type studies;

*PSS®E* means Power Systems Simulator for Engineering, being a software package used to carry out root mean square studies;

*short circuit ratio* is an analytical metric that normalises the *system strength* in MVA using synchronous fault levels at the *connection point* to the aggregate *nameplate rating* of any *embedded generating systems*;

*system strength* broadly refers to the stability of the *distribution system* and broader *power system*. It:

is typically measured by the available short circuit current or characterised by an analytical metric such as the *short circuit ratio* at any given location; and

relates to the size of the change in *voltage* for a change to the generation (or load) at a *connection point* (which can be affected by adjacent *asynchronous plant*).

*System strength* can be impacted where there is *asynchronous plant* in the area. Strong *distribution systems* exhibit better *voltage* control in response to small and large *power system* disturbances during both normal and contingency events, whilst weak *distribution systems* are more susceptible to *voltage* instability or collapse and the incorrect operation of protection systems; and

*X/R ratio* is the ratio of system inductive to resistive impedance.