Fact sheet

Connecting and Registering in the NEM

AEMO plays a significant role in establishing and modifying connections to power transmission and distribution networks in the National Electricity Market (NEM).

- For connections to the Victorian Declared Shared Network (DSN), AEMO is the primary contact point for the connection process.
- For connections to the Victorian distribution network and connections to transmission and distribution networks in other regions, the connecting Network Service Provider (NSP) is the primary point of contact for the connection process, with AEMO undertaking its Advisory Role in relation to specified negotiated performance standards.
- For all NEM connections, AEMO is the point of contact for the market registrations process.

AEMO is currently experiencing a high volume of new generator connections, with many Applicants new to the NEM and working to compressed timeframes. AEMO has prepared this fact sheet to seek to address common questions and issues in relation to connection, registration and commissioning requirements in order to support NSPs and Applicants with successful project completion.

For general enquiries, contact the AEMO support hub: supporthub@aemo.com.au

Connection process

The connection process involves four (4) key phases. We have recently worked with all NEM NSP's to prepare a unified overview of the connection process, including details of work undertaken at each phase, the respective roles and responsibilities of organisations involved in facilitating new connections, as well as indicative timeframes. The process diagram is available on our website here, Additional information is available on respective NSP websites include extensive supporting information to assist proponents. At a high level, the process involves:

1. An optional pre-feasibility stage, where the Applicant commences initial engagement with the connecting NSP.
2. Enquiry – submission of an Enquiry is the first formal stage in the process.
3. Application – submission of a connection application, including detailed technical information, proposed performance standards and system strength remediation (if applicable).

As illustrated in the connection process diagram here, this phase involves detailed technical studies. For asynchronous connections it is likely that the connecting NSP will need to undertake a Full Impact Assessment (FIA) in accordance with the System Strength Impact Assessment Guidelines. This is a complex modelling exercise that can take a significant amount of time, potentially leading to delays in finalising your application to connect. The outcome of the FIA can also impact the finalisation of the GPS and connection agreement with the connecting NSP, therefore we suggest proceeding with caution, especially when making financial or commercial decisions based on the assessment of your proposed connection to date.

4. Completion – undertake commissioning to confirm satisfactory operation of the facility.

In parallel to the assessment of technical requirements the Proponent will negotiate with the connecting NSP to establish connection contracts, will apply for Market Registration, as well as undertake construction activities including the following:

- Supervisory Control and Data Acquisition (SCADA) requirements and testing
- Energy Conversion Model (ECM) requirements.
- Obtaining a National Metering Identifier (NMI) from AEMO.

- Confirming the capability of the facility to meet the agreed performance standards.
- Commissioning plan preparation and approval by the NSP and AEMO.
- Finalise Market Registration as part of the Registration process (see further below).
- Provision of limit advice by the NSP to AEMO to implement required constraints in the National Electricity Market Dispatch Engine (NEMDE).

The AEMO Connections team (Network Development) may be contacted at: Connections@aemo.com.au

Prerequisites for Registration and Commissioning

Metering

Prior to Registration, the following must be completed:

- A NEM Compliant Revenue Metering installation has received AEMO approval (NER 7.2.1).
- The installations NMI & NMI standing data is available and either set-up or ready to be set-up in Market Systems for the Commissioning date. This includes the creation or alteration of any Registered Participant ID's.
- Metering Coordinator is appointed in respect of the connection point in accordance with clause 7.6.2a
- AEMO notes section 11 (4) of the National Electricity Law (NEL) – for an installation to be energised to take load, the Applicant will normally need to have a Market Customer (a Retailer) in place or be a Market Customer themselves prior to energisation occurring in order to ensure compliance with the NEL requirement. If the applicant is a generator, it must seek signoff from AEMO's metering department before being energised to take load.
- If the Applicant is applying to be a Generator, the Generator must not connect its generating plant until the registration is effective. It follows, prior to any energisation of auxiliary equipment AEMO requires that the installation have appropriate mechanisms in place to ensure no connection to the grid.

Metering can be contacted at: NEM.LNSP&RP@aemo.com.au

ECM and forecasting model requirements

An ECM must be provided for all semi-scheduled generators (NER) 2.2.7(c)(2). AEMO may also require an ECM from a non-scheduled intermittent generator under some circumstances (NER 2.2.3(c))[1]. The ECM should be submitted prior to lodging a registration application to avoid project delays. The ECM sign-off process involves:

- Completion (and review) of the ECM according to the guidelines on the AEMO website.
- Inclusion of all ECM SCADA signals in the signals list.
- A final review with AEMOs external modelers. Note that there is a two (2) week turnover each time an ECM is submitted to the external modelers.
- ECM sign off to be provided before a registration application can be considered (prior to Participant Registration Committee (PRC).

Forecasting can be contacted at: op.forecasting@aemo.com.au

SCADA end-to-end testing

Where SCADA is to be provided, SCADA sign-offs are required. SCADA signal list must be agreed

[1] AEMO typically requires an ECM from non-scheduled intermittent generators when they need to be modelled for security constraint purposes. This is most common in congested areas of the NEM.

on at least a month prior to commissioning. End-to-end tests of the agreed points must be performed from site to AEMO to ensure communication capabilities, including correct points mapping, scaling and polarity. Importantly, if works are required by the NSP to modify network communications infrastructure the timing of these works should align with the commissioning timeframe.

Successful points testing is required prior to Registration sign-off for the PRC. This can be undertaken by a combination of primary and secondary signal injection.

This typically involves the following:

- Complete signal list of points expected to and from AEMO to be provided, reviewed and agreed on between data owners and AEMO.
- Applicant to pass required signals to the NSP that will be passing that data to AEMO, including any intermediaries.
- NSP to provide AEMO with a list of points with ICCP IDs for mapping between systems.
- NSP to add agreed points into their systems. Applicant advised to check with NSP on their database load cycles.
- AEMO to add agreed points into ICCP systems (direct connection to the NSP), model the equipment in SCADA systems, ensure correct feeds from ICCP system, performs tests on the models and applications that the change affects. Note that there is a 2 week database load cycle.
- Point to point testing from site to AEMO to be performed.
- SCADA sign off to be provided to PRC once successful testing is achieved, prior to Registration signoff.

Importantly, secondary injection tests, particularly after energizationion, should not be undertaken without notifying AEMO under any circumstances.

Commissioning program

- A generator commissioning program should be provided at least three months prior to commissioning for transmission connections, and at least one month prior to commissioning for distribution connections.
- The commissioning program should be approved by the NSP and AEMO prior to Registration.

Other requirements

- New generators need to be added to the constraint equations inside A'MO's market systems so the power system limitations can be modelled. In some cases, these limitations require complex modelling (particularly for transient and voltage stability limits) which must be updated by the NSP and provided to AEMO for implementation in revised constraint equations. Calculating these limits can take months and AEMO requires 8 weeks for testing and implementation.
- It is increasingly important for NSP's to provide early limit advice for network outage conditions (particularly where the NSP is required to undertake analysis in PSCAD to determine those limits) to avoid application of conservative limits in real-time dispatch.

Market Registration

Market registration is a prerequisite to connecting, energising nd commissioning generating units. This process needs to be factored into any project plan to minimize the potential for delays. In summary registration allows AEMO to:

- Assess the corporate structure and organisational capability of the registering participant to

meet its obligations under the NER.

- Ensure that approvals and services are in place to meet settlement and prudential requirements.
- Ensure that any appropriate licenses and approvals (jurisdictional or otherwise) are in place.
- Determine that the connection and metering configuration is compliant with the NER and appropriate based on generator classifications.
- Assess the technical parameters, performance and capability of the generating units against the requirements of the NER and establish these parameters within our IT systems.
- Establish IT systems access with the participant that facilitate data exchange and participation in NEM operational processes.
- Collate priority participant contact information.

Further detail on the Registration process and Registration requirements, including guides and application forms, can be found on the AEMO website.

Onboarding may be contacted at: onboarding@aemo.com.au

Energisation and commissioning

Forecasting Model Requirements

Ensuring ECM SCADA signals are working as expected early in the commissioning process will enable accurate forecasting (AWEFS/ASEFS) models to be developed and implemented (three week lead time), and avoid potential delays to commissioning.

The following requirements apply to Wind Farms and Solar Farms commissioning:

- For Wind Farms, the expedited forecasting model needs to be implemented in parallel to compliance testing activities which is dependent on working SCADA.
- For Solar Farms, forecasting models can be expedited and may not require all SCADA testing to have been completed prior to implementation.
- For all new Solar Farm registrations, an expedited model will be implemented to avoid potential delays to commissioning.

AEMO requires accurate forecasting models in order to match supply and demand, and to manage system frequency and system security.

Energisation

In order to energise a facility, it is general practice to register as a generator. In some cases, and provided there is not significant load (e.g. more than 10 MW), there may be flexibility to assign the NMI to an existing retailer or otherwise register as a customer and energise the facility's connection assets (e.g. transformer and switchboard) - noting that generating units must not be connected to the grid until generator registration. It should be noted that registration as a customer can create significant additional work for the generator and AEMO, and is therefore not the preferred approach and should only be considered in extenuating circumstances.

Commissioning

Commissioning tests, including hold point approvals, must be coordinate with AEMO (Network Development) and the connecting NSP. Pursuant to NER 5.7.3, AEMO may apply operational measures where issues are experienced during the commissioning process. If tested performance shows potential for adverse impacts to existing users, network operation or AEMO's ability to manage power system security, or there is a material difference between modelled and tested performance bringing into question the validity of the technical assessment used to establish the agreed performance standards, AEMO and the NSP may require output to be restricted, or, if

deemed necessary, instruct the generator to disconnect until the issue is resolved.

Post-commissioning

Post-commissioning the following is required:

- An update to modelling information must be provided to AEMO and the NSP within three months of commissioning.
- A compliance monitoring program must be instituted no later than 6 months from registration of performance standards or commencement of operation.

Glossary

ASEFS	Australian Solar Energy Forecasting System
AWEFS	Australian Wind Energy Forecasting System
DSN	Declared Shared Network
ECM	Energy Conversion Model
ICCP	Inter Control Centre Protocol
NEM	National Electricity Market
NER	National Electricity Rules
NEMDE	National Electricity Market Dispatch Engine
NMI	National Metering Identifier
NSP	Network Service Provider
PRC	Participant Registration Committee
SCADA	Supervisory Control and Data Acquisition