Interim arrangements for utility scale battery technology

Introduction

**Purpose**

This document has been prepared to expedite the entry of utility scale battery projects to the NEM in the short term. It sets out AEMO’s views on how to apply the current National Electricity Rules (NER) to battery projects, recognising that there may be scope to improve the NER framework going forward.

The document describes interim arrangements to apply in a number of key areas including registration, metering, SCADA, negotiation of generator performance standards (GPS) and engagement with Network Service Providers (NSPs). Further context is also provided through example questions and answers.

AEMO will assess the conditions for connection, registration and operation of battery energy systems on a case-by-case basis in accordance with the NER.

**Background**

AEMO is working to support a number of processes underway to trial the potential of battery technology to provide a variety of power system security and reliability services.

The NER can accommodate batteries and other energy storage providers, but it is not always clear how a battery fits within the current framework. A number of inquiries have been received by AEMO from proponents of network-connected battery storage projects who have requested information relevant to installation and operation of both standalone battery systems as well as battery systems installed with new or existing generation. This document provides guidance on AEMO’s view on how the NER can be applied to utility scale batteries in the short term, pending an investigation into the security and reliability service potential of the technology.

**Interim arrangements to inform review of Rules framework applying to energy storage**

While the comments detailed in this document reflect the existing NER, AEMO considers that there may be scope to improve the NER as they apply to batteries (and potentially other forms of storage). AEMO intends to work with stakeholders, international experts and the AEMC to review our experience under the current framework and assess whether there is scope for improvement.

AEMO will conduct its review over the next 12 months. The experience that AEMO and other interested parties gain under the interim arrangements will be invaluable in developing comprehensive and robust long term arrangements. While this is underway, we suggest that the current arrangements could transition to a new framework if and when the changes to the NER are introduced.

Overview of interim arrangements

**Registration**

AEMO’s policy is that proponents of battery systems with an aggregate nameplate rating greater than or equal to 5 MW, whether directly connected to the network or integrated behind the meter with new or existing generation are to be registered as both Generators and Market Customers. Their generating units should be classified as scheduled and market, and the load classified as scheduled load. In the case of a generating system with a battery that is integrated with another type of generation and will never be charging from the grid, AEMO will consider a proposal that the proponent not register as a Market Customer, provided that appropriate arrangements are put in place for the charging activity to be dispatched through central dispatch for reasons of power system security and operation.

AEMO has recently updated its ‘Classification and Exemption Guide’ and ‘Generator Registration Guide’ to reflect this.[[1]](#footnote-2)

**Metering**

As with any other new or modified generation project, AEMO will assess proposed metering arrangements on a case-by-case basis for battery energy systems. Stakeholders should consider the following principles when developing a proposal for generation and load for a battery system of 5MW or greater:

* Parties must register a metering installation with AEMO prior to being able to operate in the NEM.[[2]](#footnote-3)
* Battery systems may be connected through one, two or more connection points to the network. A NER-compliant metering installation will be required for each connection point.[[3]](#footnote-4)
* Parties considering a single connection point for charge and discharge of the battery system must ensure that there is a single Financially Responsible Market Participant (FRMP) registered for that connection point.[[4]](#footnote-5) Consideration should be given to the need for individual meters for battery charge and discharge, based on whether batteries are expected to be both charging and discharging in a given 5-minute dispatch period (e.g. for provision of contingency Frequency Control Ancillary Services[[5]](#footnote-6) (FCAS)).
* Multiple (i.e. two or more) connection point arrangements for charge and discharge can be accommodated by a NER-compliant metering installation but are likely to require additional switching and metering infrastructure. In the case of multiple connection points, separate FRMPs can be classified for charge and discharge connection points.
* Parties looking to generate large scale generation certificates (LGCs) for the purposes of the Renewable Energy Target should give consideration to requirements for creating and validating LGC claims when developing a proposal for a NER-compliant metering installation.[[6]](#footnote-7)
* The use of ‘logically calculated’ metering arrangements (i.e. metering inferred via calculation of power flows through balance of plant or other ancillary systems) may be considered by AEMO, but they do not replace the need for NER-compliant metering installations. Logical metering arrangements must be approved by AEMO.

**SCADA and data collection**

Secure and reliable operation of the power system is only possible if the necessary energy and system services required by the NEM can be accurately forecast and dispatched by AEMO, the system operator.

Battery energy systems have the ability to shift the time at which energy produced from renewable sources is consumed. For this reason, AEMO’s systems for forecasting generation of wind energy (i.e. AWEFS), solar energy (i.e. ASEFS) and underlying demand will have to take in a level of real-time information on how battery systems are interacting with other generation assets.

The power system must be operated within its technical limits at all times; in order to understand the envelope of the power system technical capability in real-time, AEMO will need to have a basic understanding of the ability of battery energy systems above the registration threshold to provide system services.

Battery systems that have a nameplate rating greater than or equal to 5 MW will have to provide to AEMO via SCADA:

* Current state of charge in MWh
* Current charge rate in MW
* Current discharge rate in MW
* Any other data required under their generator performance standard
* Any other data required by the Market Ancillary Services Specification (MASS) if operating in FCAS markets.

Parties that are considering provision of FCAS must register accordingly and should ensure that suitable equipment is installed to monitor and record the response from generating units in accordance with the requirements of the MASS.

**Engagement with NSPs**

Parties interested in connecting a battery energy system should approach their relevant NSP in the first instance to discuss the feasibility of their proposal and the process for investigating possible connection options. AEMO will provide support to each NSP as required by existing processes used to establish a new connection for a generating system or modify an existing network connected generating system.[[7]](#footnote-8)

As a part of the established process for new connections, following lodgement of a connection enquiry with the relevant NSP, applicants will:

* assess feasible locations for connection of the proposed generating system;
* negotiate a suitable design for ancillary infrastructure required at the connection location in accordance with obligations of the connection applicant and the NSP under the NER;
* propose a set of GPS to the relevant NSP that detail the level of technical performance required for on-going operation of the battery system (as both a scheduled generating system and scheduled load in this case).

The performance standards that will apply to the battery system will be based on the relevant access standards and the results of simulation studies where batteries are both charging and discharging.

AEMO’s role in this connection process is providing data as required to connection applicants and undertaking modelling and due diligence to support assessment of the GPS proposed by the connection applicant.

**TUOS and DUOS**

Under the NER, it is the responsibility of NSPs to negotiate in good faith with connection applicants on network ‘Use of system’ charges (i.e. TUOS for Transmission NSPs (TNSPs) and DUOS for Distribution NSPs (DNSPs)) and other connection service charges.

Intending participants should discuss the process for the negotiation of ‘use of system charges’ with the relevant TNSP/DNSP consistent with principles set out in the NER. Each NSP determines ‘use of system’ charges according to its own pricing methodology.

In Victoria, AEMO is responsible for setting TUOS charges as part of its Victorian TNSP role. In the absence of a clear regulatory framework, AEMO is liaising with the AER in order to establish an appropriate way forward. There would be merit in amending the Rules to clarify this issue.

**Participation in ancillary services markets**

Parties looking to participate in FCAS markets must comply with the requirements of the MASS[[8]](#footnote-9) and register as generators appropriately as ancillary service generating units.

Although the current version of the MASS has not been written to explicitly consider arrangements for Fast Frequency Response (FFR) services, section 7.3 of this document provides a basis for AEMO to undertake trials to test the performance of new technologies with registered ancillary service generating units. There may also be scope to demonstrate the ability of different technologies to provide FFR services as a part of the AEMC’s rule change process on Inertia Ancillary Services Markets, which is currently under development. [[9]](#footnote-10)The AEMC has recently set out its intention to establish a Frequency Control Frameworks Review to explore how a framework for FFR services might operate.[[10]](#footnote-11) AEMO encourages all interested stakeholders to maintain a watching brief on this review as the FFR framework is developed.

There may also be scope for battery energy systems to provide network support and control services to a TNSP, or in certain limited circumstances, to AEMO. The applicable regulatory framework is described in the AEMC’s final determination on network support and control ancillary services (NSCAS).[[11]](#footnote-12)

**Contacts for further information**

* For further information on how to connect to the NEM please contact AEMO’s connections team:

[connections@aemo.com.au](mailto:connections@aemo.com.au)

* For further information on the registration process, please contact AEMO’s onboarding team:

[onboarding@aemo.com.au](mailto:onboarding@aemo.com.au)

* For further information on any other specific issue please contact the AEMO support hub:

[supporthub@aemo.com.au](mailto:supporthub@aemo.com.au)

Frequently Asked Questions

**REGISTRATION - STANDALONE INSTALLATIONS**

**If I install a 5MW battery, must I apply for registration?**

Yes. AEMO has determined that any battery of 5MW capacity or more has the potential to impact power system security and requires that a person engaged in generating electricity using such a battery must be registered in the NEM. For further information, see AEMO’s Guide to Generator Exemptions & Classification of Generating Units.

**Why isn’t the battery load considered to be an auxiliary load?**

Although there is no standard definition of ‘auxiliary load’, AEMO uses the term to denote the components of a generating system that consume electricity to provide operational assistance to generating units, especially where this may support maintenance activities or assisting the generating system to come online. Batteries that are less than 5MW may be considered to be auxiliary load.

**REGISTRATION - INSTALLATIONS AS PART OF AN EXISTING GENERATING SYSTEM**

**If I install a 100MW battery as part of an existing market generating system, must I apply to register as both a Generator and a Customer?**

If the battery energy system has a nameplate capacity (individually or in aggregate) that is greater than or equal to 5MW, then the simplest approach is to register the battery separately to the existing market generating system as both a Generator and a Market Customer, classified as Scheduled. In this scenario, the battery energy system would operate as a separate unit behind the existing point of connection. However, AEMO will consider alternative proposals that do not compromise the reliability or security of the power system.

**REGISTRATION – CLASSIFICATION**

**I am planning on installing a 5MW battery installation. Why does it have to be scheduled?**

As a battery can change its output virtually instantaneously, even a 5MW battery can have an impact on power system security and reliability. AEMO will need timely and accurate information about when and how a battery is to be charged or discharged. The systems that are in place for scheduled generating units and scheduled loads facilitate the provision of this information to AEMO.

**Is a battery installation considered to be intermittent generation and can it be classified as semi-scheduled?**

No. The NER definition of ‘intermittent’ requires that the output not be readily predictable. Battery storage installations are expected to be controlled, so they don’t meet this requirement.

Hence, a battery installation cannot be classified as semi-scheduled.

The situation becomes complicated if you are proposing to install battery storage within an existing semi-scheduled generating system. This would require a reconsideration of the classification of the whole site. AEMO may consider that the combined installation will be reclassified as scheduled, but will make this determination on a case by case basis.

**METERING & SETTLEMENTS**

**I am proposing a single NMI for my generating system and battery storage. Is this acceptable?**

The FRMP is responsible for ensuring that each connection point has a metering installation and a NMI (See NER 7.1.2(a), 7.3.1A(a) & 7.3.1(e) regarding NMIs, and NER 3.15.3 for financial responsibility).[[12]](#footnote-13)

MSATS, which is AEMO’s market settlements system, will only accept a NMI Classification Code of load or generator. It cannot be both. Hence, if the battery and generating system are using the same connection point, they can have the same NMI for both charging and discharging only if it is classified under NER 3.15.3(a) as a generation connection point for settlement purposes.

**Do I need a physical metering installation at my connection point?**

Yes, you need to have an NER compliant metering installation at each connection point. AEMO may consider the use of “logical metering” algorithms, but they do not replace the need for NER-compliant metering installations. Logical metering arrangements must be approved by AEMO.

**PERFORMANCE STANDARDS**

**What performance standards will be required?**

Performance standards will be required for installations where the aggregate nameplate capacity (total instantaneous peak capacity) is 5 MW or greater.

If installed as part of an existing generating system or Customer connection, and there are changes to the existing plant and/or performance of the existing plant, there will be requirement for AEMO and the relevant NSP to approve settings/configuration changes and revised performance standards. Relevant NER clauses are:

* 5.3.4 – Application for connection
* 5.3.4A – Negotiated access standards
* 5.3.9 – Procedure to be followed by a Generator proposing to alter a generating system
* S5.2.2 – Application of Settings

The Generator Performance Standard template will apply as the starting point for performance standards, with some modifications to reflect the capability of the battery to operate as both a ‘generator’ and a ‘load’. The maximum operating level is the peak instantaneous generating capability of the battery, and minimum operating level is the peak instantaneous absorption capability of the battery. The performance requirements relating to reactive capability and dynamic response will equally apply for both 'generator' and 'load' operating modes. Additional provisions may apply, such as S5.3.10, and other performance requirements by agreement (e.g. Fast Frequency Response). Additional requirements may apply, and be reflected in the performance standards, based on specific requirements (e.g. ESCOSA requirements).

For details of AEMO’s information, modelling and testing requirements, refer to the AEMO website or contact [connections@aemo.com.au](mailto:connections@aemo.com.au).

**OPERATIONAL ISSUES**

**How will AEMO’s systems deal with dispatch bids for a Scheduled Load and offers and generation bids for a Scheduled Generator?**

NEMDE will dispatch both, regardless of whether the bids/offers are inconsistent with each other.

It is up to the Market Participant to ensure that their bids/offers reflect their intentions.

**Would AEMO impose any ramp rate restrictions on a battery? If so, would they be implemented as a registration condition or a constraint equation?**

It depends on the size of the battery. If it were significant to have an impact on power system security, the fact that they can respond in less than a second to a price spike/fall would have a similar effect on the power system to a contingency event. This is particularly the case if a number of different batteries were to all respond in a similar manner in response to a change in price. AEMO has the power under NER 4.9.5(a)(3) to set a ramp rate limit that a generator must follow when moving to a new dispatch target. These ramp rate limits can be implemented through NEMDE in the dispatch process. Such ramp rate limits would not apply to the provision of contingency FCAS or NLCAS, where a more rapid response can be of value to the power system.

**ANCILLARY SERVICES**

**What do I need to do to be able to provide ancillary services using my battery?**

The provision of market ancillary services depends on whether you can demonstrate compliance with the Market Ancillary Service Specification.

**Would testing for FCAS, Fast Frequency Response etc. be similar to conventional generation?**

TheMarket Ancillary Service Specification describes a process for testing the response of generating systems for the existing 8 FCAS markets. There is currently no formal market structure for ‘Fast Frequency Response’ (FFR) services, although the AEMC is set to release a draft determination on 7 November 2017 on the Inertia Ancillary Services Market Rule.

New arrangements for inertia markets under consideration by the AEMC include a potential mechanism for NSPs to contract FFR services to act as a substitute for inertia where AEMO and the NSP agree that this approach will meet system security obligations. AEMO expects that there will be opportunities to undertake proof-of-concept testing of FFR type services over the medium term to inform new market arrangements. The objective of this proof-of-concept testing will be identify suitable technical parameters and market features for a FFR specification(s) that could be applied more broadly in the NEM.

These issues will be considered more holistically as a part or a review of the framework for frequency control. The Terms of Reference for AEMC’s Frequency Control Frameworks Review published on 7 July 2017[[13]](#footnote-14) indicate that the recommendations of the Review may include proposed revisions to technical standards, refinements to existing FCAS markets, the establishment of new markets or other changes to the regulatory and market framework. The broader set of issues relating to how FFR should be included in existing or new market arrangements will be considered by AEMC in this Review. AEMO will be collaborating with the AEMC to inform the findings of the Review and will channel input from the Ancillary Services Technical Advisory Group[[14]](#footnote-15) to support thorough assessment of potential new arrangements.

See the AEMC’s website for further information at:

<http://www.aemc.gov.au/Markets-Reviews-Advice/Frequency-control-frameworks-review>

**TRANSMISSION/DISTRIBUTION USE OF SYSTEM CHARGES**

**How will TUOS/DUOS be charged?**

This is a matter that should be referred to the TNSP/DNSP who owns the network to which the applicant is proposing to connect its battery.

In Victoria, applications for connection to the transmission network are directed to AEMO. In the absence of a clear regulatory framework, in the exercise of its Victorian Transmission function, AEMO is liaising with the AER to establish an appropriate way forward.

**PARTICIPANT and REGISTRATION FEES**

**What kind of participant fees are payable by Registered Participants with battery storage?**

Different charges apply to Generators and Market Customers. Interested parties should view AEMO’s current fee schedule on AEMO’s website, available at:

<http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Participant-information/Fees-and-charges>.

**Where do I find details of participant fees on AEMO’s website?**

You can find it in the ‘About AEMO’ section. The link is here:

<http://www.aemo.com.au/About-AEMO/Energy-market-budget-and-fees>

1. <http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Participant-information/New-participants/Exemption-and-classification-guides> [↑](#footnote-ref-2)
2. See NER 7.1.2. [↑](#footnote-ref-3)
3. See NER 7.3.1A. [↑](#footnote-ref-4)
4. See NER 3.15.3. [↑](#footnote-ref-5)
5. For further general information on FCAS refer to:

   <https://www.aemo.com.au/-/media/Files/PDF/Guide-to-Ancillary-Services-in-the-National-Electricity-Market.ashx> [↑](#footnote-ref-6)
6. For further information refer to the Clean Energy Regulator:

   <http://www.cleanenergyregulator.gov.au/RET/Scheme-participants-and-industry/Power-stations/Large-scale-generation-certificates/Creating-and-registering-large-scale-generation-certificates> [↑](#footnote-ref-7)
7. Refer to connection process overview for more information:

   <https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Network-connections/Transmission-and-distribution-in-the-NEM--process-overview> [↑](#footnote-ref-8)
8. Further information on the MASS, which is currently under consultation, is available here:

   <https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Amendment-Of-The-Market-Ancillary-Service-Specification> [↑](#footnote-ref-9)
9. On 27 June 2017, the AEMC extended the period of time for making the draft rule determination for this rule change request until 7 November 2017. [↑](#footnote-ref-10)
10. <http://www.aemc.gov.au/Markets-Reviews-Advice/Frequency-control-frameworks-review> [↑](#footnote-ref-11)
11. <http://www.aemc.gov.au/Rule-Changes/Network-Support-and-Control-Ancillary-Services> [↑](#footnote-ref-12)
12. The Chapter 7 references will change from 1 Dec 2017, but the principles will be the same, with the exception that the Metering Coordinator will assume responsibility for the metering installation. NER 7.1.2(a) becomes 7.2.1(a), 7.3.1A(a) becomes 7.8.1(a) and 7.3.1(e) becomes 7.8.2(d). [↑](#footnote-ref-13)
13. <http://www.aemc.gov.au/getattachment/900f37e2-efa4-4c7f-99ea-fa9c78b41993/Terms-of-reference.aspx> [↑](#footnote-ref-14)
14. <https://www.aemo.com.au/Stakeholder-Consultation/Industry-forums-and-working-groups/Other-meetings/Ancillary-Services-Technical-Advisory-Group> [↑](#footnote-ref-15)