Australian Energy Market Commission

RULE DETERMINATION

National Electricity Amendment (Generating System Model Guidelines) Rule 2017

Rule Proponent
Australian Energy Market Operator

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About the AEMC

The AEMC reports to the Council of Australian Governments (COAG) through the COAG Energy Council. We have two functions. We make and amend the national electricity, gas and energy retail rules and conduct independent reviews for the COAG Energy Council.

Summary

The Australian Energy Market Commission (AEMC or Commission) has made a final rule that clarifies the scope and level of detail of model data that registered participants are required to submit to the Australian Energy Market Operator (AEMO) and network service providers.

The Commission considers that increased clarity regarding the arrangements for model data provision will support more efficient operation of and investment in the national electricity market, particularly as this relates to maintaining the security of the power system.

Models and power system studies

Models are mathematical representations of how particular equipment, such as a generating unit or network equipment, will function under different conditions. They are used as inputs to broader modelling studies of the power system (known as power system studies), which allow parties to examine how the power system will function under a range of different conditions. These power system studies are used by generators, AEMO and network service providers to inform a number of processes, including the development of constraint equations, the planning of networks, the development of generator performance standards, the assessment of settings of control systems and protection systems of plant and networks, and meeting minimum fault level requirements.

Various changes in power system conditions are making it more difficult to undertake accurate power system studies, particularly the decrease in system strength occurring in many parts of the grid. In order for power system studies to remain accurate and effective, it is becoming increasingly important that the model data used as inputs to these studies is sufficiently detailed to accurately reflect the performance of generating units and other equipment under these changed power system conditions.

This final rule is therefore designed to provide various parties with access to the model data that is needed to support effective power system studies in a changing power system environment.

The final rule expands the existing NER framework for model data provision

The final rule amends the existing framework in the national electricity rules (NER) to clarify, as well as increase the range of circumstances in which parties must provide model data to AEMO and network service providers.

The final rule requires AEMO to set out, in its power system model guidelines, what model data will be required to be provided by participants and the specific circumstances or conditions under which that model data will be required.

The final rule also sets out principles that AEMO must have regard to when it develops the guidelines and data sheets. These are:

- a requirement for AEMO to consider the costs faced by participants in providing model data,

- the protection of confidential model information, and
- the range of modelling information needed by network service providers to fulfil their obligations under the NER or jurisdictional electricity legislation.[1]

In making the final rule, the Commission recognises that while the provision of model data to AEMO and network service providers is likely to provide overall benefits to the market, participants will face costs in meeting obligations to provide model data.

The Commission considers that these costs can be best managed where there is predictability and clarity regarding the nature of these obligations. The Commission considers this will help to reduce uncertainty with respect to regulatory obligations, by allowing participants to effectively plan and account for these costs in their commercial decision making processes.

Background and rationale

Changes in the power system, particularly a reduction I n system strength in some areas, mean that more detailed power system studies are required to understand how the power system will function under certain conditions. These changes also affect how other, previously not modelled, equipment interacts with the power system. Such equipment may be owned by generators, transmission network service providers, distribution network service providers, market network service providers, or customers on the transmission or distribution networks.

Under these changed system conditions, the use of less accurate models may lead to less accurate power system studies, which may reduce the ability of AEMO and network service providers to accurately determine how generators and the power system more generally may behave. This may lead to less effective operation of the power system, for example due to the development of less accurate constraint equations, inappropriate generator performance standards and less effective procurement of ancillary services. This could reduce system security and potentially increase the risk of a cascading failure and black system event.

Although there is an increasing need for accurate model data, the NER do not explicitly specify what kind of model data must be provided in all circumstances. This could result in some uncertainty about what types of models are sufficient for registered participants to meet their obligations and to address the issues described above.

This final rule is therefore intended to provide increased certainty for AEMO and registered participants regarding what model data must be provided by what parties, and the circumstances in which this occurs.

Features of the final rule

The final rule reflects the issues raised by AEMO in its rule change request but contains a greater level of detail than the proposed rule in order to address these issues, , while retaining AEMO's overall approach.

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1 Jurisdictional electricity legislation is defined in the National Electricity Law (NEL) as an Act of a participating jurisdiction (other than national electricity legislation), or any instrument made or issued under or for the purposes of that Act, that regulates the generation, transmission, distribution, supply or sale of electricity in that jurisdiction.

The final rule expands the application of the existing NER model data provision framework to apply to additional types of participants and the plant they operate. This is designed to provide AEMO and network service providers with model data for a broader range of equipment owned by a broader range of participants than previously allowed for under the NER.

The final rule therefore places obligations on generators, network service providers, market network service providers, certain network users and prospective system restart ancillary services (SRAS) and network support and control ancillary services (NSCAS) providers to provide information in accordance with the requirements of the NER and the revised model guidelines and data sheets.

In making the final rule, the Commission has also sought to strike an appropriate balance in terms of the regulatory obligations that should be set out in the NER against those that are better placed in AEMO's power system model guidelines and data sheets.

Accordingly, under the final rule, the NER set out the requirements on participants to provide relevant modelling information and then AEMO is required to specify additional, operational details in the guidelines and data sheets. This detail includes:

- specific data provision requirements, including what types of model data different participants are required to provide under the relevant NER provisions
- the model accuracy requirements that are applicable to each type of model provided, and
- the precise circumstances (e.g. power system conditions) in which it will require the different types of model data.

The NER set out the higher level obligations for parties and the requirements to comply with AEMO's model guidelines. This is designed to clarify for registered participants that they must meet the detailed, operational requirements set out in the guidelines, as required by the NER.

The final rule contains a number of changes from the draft rule

The AEMC published a consultation paper and a draft rule determination on the rule change request. This final determination is informed by stakeholder submissions to both the consultation paper and draft determination.

Following consultation with stakeholders, the Commission identified a number of changes to the draft rule that are required to enhance clarity for all participants and to support better system security outcomes.

The Commission has also made a number of additional changes to reflect the *Managing power system fault levels* rule change.

Network service providers' access to model data

In the draft rule, the Commission amended the NER model data provision framework to make it clearer as to when AEMO and network service providers are provided with data. As discussed in further detail below, this included an ability for AEMO to request additional model data from generators, in certain circumstances.

The Commission has further considered the need for network service providers, particularly distribution network service providers, to be provided with specific

additional model data from other registered participants. The Commission understands that this model data is needed in certain circumstances so that network service providers can fulfil various obligations under the NER.

In submissions to the draft determination, several network businesses therefore suggested that they should have the ability to request this information directly from participants, in certain circumstances.

In addition, there are new NER obligations on network service providers, arising from the *Managing power system fault levels* rule change, to assess the impact of new connecting generators or market network service providers on system strength. Such assessments may only be conducted accurately if network service providers have, or are provided with, updated, detailed model data of plant owned by existing registered participants located in close proximity to new connecting participants.

While the Commission recognises that there are certain circumstances where network service providers are likely to require access to additional model data, the Commission also considers that AEMO remains the appropriate party that is able to request that additional model data from participants. So while network service providers will receive this information at the same time as it is provided to AEMO, restricting the initiation of a request to AEMO only will help provide greater predictability for participants as to when additional model data may be requested, which will help limit uncertainty around potential costs. To provide additional clarity in regards to these issues, the Commission has made a number of changes from the draft to the final rule.

- Firstly, the final rule includes a principle based requirement for AEMO to have regard to the information requirements of transmission and distribution network service providers in relation to meeting their obligations under the NER and jurisdictional electricity legislation.

  The Commission expects that this requirement will result in the inclusion in the guidelines of processes and tests that are specifically designed to provide clarity around network service providers' ability to access the kinds of model data required to meet their various obligations.

- Secondly, as discussed in further detail below, the final rule enables AEMO to request additional model data from existing registered participants in various circumstances, including where in AEMO's reasonable opinion there is a risk that the registered participant's equipment may have an adverse impacts on the power system, system security, system strength and other network users. When provided, the information is provided to both AEMO and the relevant network service provider.

  The Commission expects that this ability may be used by AEMO to request model data on behalf of network service providers, where that model data is needed by the network service providers in order to meet their various NER obligations, particularly where equipment owned by a specific existing participant may be having an adverse impact on system strength and system security.

- Thirdly, the final rule enables AEMO to request additional model data from existing registered participants, in cases where network service providers need updated model data from those existing participants, in order to accurately assess how a new connecting participant may impact on overall system strength.

  The Commission considers that this ability may be used by AEMO in supporting network service providers in undertaking their system strength impact assessment, related to meeting the relevant obligations under the *Managing power system fault levels* rule change.

The Commission considers that these changes from the draft rule appropriately address the need of network service providers to access updated or additional model data.

Connection process and negotiated access standards

The draft rule did not address the issue of when model data should be provided by connection applicants to network service providers and AEMO as part of the process of those parties assessing the connection applicant's proposed negotiated access standards.

AEMO in its submission to the draft determination suggested that the timely and complete submission of all models and other information related to the assessment of a proposed negotiated access standard should be a requirement that connection applicants have to meet.

The Commission understands that AEMO and network service providers' ability to assess proposed negotiated access standards relies on the provision of accurate model data, and therefore, the network service provider and AEMO are not able to properly assess the impact of a proposed negotiated access standard until all required information has been provided by the connection applicant.

The final rule therefore makes it clear that AEMO and the relevant network service provider are only required to respond to a proposal for a negotiated access standard submitted by a connection applicant within the deadlines set in the NER, once all information required for that assessment has been submitted by that connection applicant.

Clarity as to when AEMO can request data

In the draft rule, the Commission amended the NER model data provision framework to make it clearer as to when generators, market network service providers, network service providers and certain network users are required to provide model data to AEMO and, where relevant, network service providers.

One aspect of these amendments in the draft rule was to allow AEMO to request *additional* model data from existing generators, outside of the circumstances of connection or alteration of plant. The Commission considered that AEMO may have elected to exercise this ability in circumstances such as when surrounding power system conditions had changed, necessitating additional model data so that AEMO could continue to accurately model the impacts of the existing plant. However, this ability for AEMO to request additional model data only applied to generators and did not extend to an ability to request additional model data from other participants, such as network service providers, market network service providers or certain network

users, including customers. The draft rule also did not set out any explicit conditions under which AEMO could request that additional data from existing generators, or any form of "test" which would provide more clarity to the market as to when AEMO may exercise this ability.

The Commission has further considered that changing power system conditions, including changes in levels of system strength, may impact AEMO and network service providers' ability to adequately model the power system. In order for these parties to be able to continue to accurately model the power system, they may need access to additional model data about existing plant. This may include access to additional model data related to plant that belongs to other network service providers, market network service providers and certain network users, including customers.

Accordingly, the Commission has made a number of changes from the draft rule to the final rule, in order to clarify that AEMO may exercise its discretion to request additional model data from a range of existing registered participants, including generators, network service providers, market network service providers and certain network users, including customers.

As per the draft rule, clauses related to the request of additional data, this model data once requested by AEMO is provided to the relevant network service provider.

These clauses also set out the various circumstances when AEMO may exercise its discretion to request additional model data. These specific conditions are where, in AEMO's opinion, the generator, network service provider, market network service provider or customer plant in question is likely to adversely affect the power system, system security or another network user.

Inclusion of this set of "adverse impact" tests will provide clarity to the market as to when AEMO may request additional model data.

Improving this clarity in the NER will provide more certainty to both AEMO and to participants as to when additional data may be requested.

The Commission has therefore made the following changes from the draft to the final rule:

- The final rule expands on the range of participants from whom AEMO may request additional model data, to specifically include network service providers, market network service providers, and certain network users, including customers.
- The final rule also introduces a new "test", being a specific set of conditions under which AEMO is able to request this additional model data. Specifically, AEMO may only request this additional model data if, in its reasonable opinion, there is a risk that the plant or equipment in question will adversely affect the power system or the use of a network by a network user, or have an adverse system strength impact.

Reasonable endeavours for AEMO to support multiple software products

The draft rule introduced an obligation on AEMO to use reasonable endeavours to accept model data in a range of software simulation products and versions. The

purpose of this obligation was to help manage costs for participants, by allowing them to select the software package through which they would provide model data.

Following consultation with stakeholders, the Commission has given further consideration to this requirement. The Commission now considers that the additional costs incurred by AEMO and network service providers in order to be able to accept model data in a range of software packages may outweigh the potential benefits.

The Commission understands that the practical effect of this clause may have caused the increase of costs on an aggregate level in the NEM, because it would have required AEMO and network service providers to maintain and build the capabilities for running power system simulations on multiple platforms. The costs of this would have been passed on to consumers and registered participants in the NEM.

Furthermore, the final rule includes a general principle obligation on AEMO to have regard to the reasonable costs of efficient compliance by registered participants, compared to the likely benefits from the use of the information when developing the guidelines and data sheets. This requires AEMO to have regard to the costs of compliance when setting out what format model data must be provided by participants, and therefore to consider whether the cost of having that additional information is proportionate to the benefits arising from the use of that additional information.

The Commission considers that in meeting this principle, AEMO will give adequate consideration to how the costs incurred in supporting various software packages are weighed against the relative benefits, to the extent that this will support the efficient compliance by participants with the requirements of the guidelines.

The Commission considers that given the general nature of this obligation, more detailed and prescriptive measures are not necessary to limit participant costs.

The final rule therefore removes the explicit requirement on AEMO to use reasonable endeavours to accept a range of software simulation products and versions.

Confidentiality of information

The final rule requires AEMO to have regard to the sensitivity of model data when developing the guidelines and data sheets.

The draft rule required AEMO to specify in its guidelines whether it would treat any of the information provided to it under the model data provision framework as confidential information. However, the draft rule did not place an explicit obligation on AEMO, and where relevant, network service providers, to treat the information they receive under the model data provision framework as confidential information.

The Commission has given further consideration to this issue and considers that the protection of confidential model data is better addressed in the NER than in the guidelines. The Commission considers that including an explicit NER requirement on the recipients of model data, including AEMO and the relevant network service provider to treat that data as confidential, will provide greater clarity for parties that are required to submit model data.

The Commission has therefore made the following changes from the draft to the final rule:

- Firstly, the final rule requires AEMO and network service providers to treat all relevant information they receive as confidential information.
- Secondly, the final rule removes the requirement that AEMO must state in its guidelines whether it will treat any of the information submitted to it as confidential information.

The provision of model source code

The draft rule required registered participants to provide source code, when submitting model data, under the provision that this source code could only be provided where it was actually available. This was intended to allow for cases where registered participants are not able to provide EMT-type source code to AEMO.

The Commission further considered that the wording related to the provision of source code "where available" in the draft rule could have been misinterpreted to mean that so that source code for RMS-type models would may not need to be provided to AEMO.

The Commission also understands that typically source code for EMT-type model data will not be required by AEMO, however source code for RMS-type data typically would be. However, consistent with the Commission's general approach that AEMO should provide clarity by setting out in the guidelines the circumstances in which different types of model data is required, it should also be required to specify the circumstances in which model data source code is required.

The Commission has therefore made the following changes from the draft to the final rule:

- Firstly, the final rule removes the words "where available" from the relevant clauses of the NER and requires registered participants to provide source code, when submitting model data to AEMO.
- Secondly, the final rule requires AEMO to define in the guidelines the circumstances in which registered participants must to provide model source code.

How the final rule meets the National Electricity Objective

Having regard to the issues raised in the rule change request, the Commission is satisfied that the final rule will, or is likely to, contribute to the achievement of the National Electricity Objective (NEO) by:

- **supporting efficient operation and security of the NEM** by allowing access to appropriate model data to support more effective and accurate power system studies. These improved studies will in turn allow for a better understanding of the state of power system, including whether or not the system is likely to be secure under specific conditions. This will enable more effective power system operation and procurement of ancillary services, to support a more secure power system.
- **supporting efficient investment in the NEM** by allowing for more accurate power system studies to support long term network and generation asset utilisation planning. Better long term planning will support more efficient

investment outcomes by allowing for effective integration of a greater range of generating technologies in the future.

Contents

1 AEMO's rule change request

1.1 The rule change request

On 31 October 2016, the Australian Energy Market Operator (AEMO) submitted a rule change request to the Australian Energy Market Commission (AEMC or Commission) seeking:

- to broaden the scope of application of the generating system model guidelines, the generating system setting data sheet and generating system design data sheet to include non-generating power system components.
- to allow for more detailed and accurate modelling and simulation of the power system to manage power system security with rapidly changing power system dynamics and new generation technologies.
- to allow for more efficient procurement of ancillary services, and more accurate understanding of the technical capability of plant for the provision of new ancillary services.

A key aspect of AEMO's proposed rule was the introduction of a specific obligation on generators to provide AEMO with model data[2] required to perform specialised electromagnetic simulation analysis. The proposed rule specified that this data would be provided in circumstances such as where a generator was connected through power electronic interfaced technologies.

The proposed rule also allowed AEMO to request this data from any generator in those situations where, in AEMO's reasonable opinion, the generating system would adversely affect other network users, power system security, or quality or reliability of supply of the power system.

1.2 Current arrangements

The NER currently set out a framework for the provision of model data by generators to AEMO and network service providers (referred to throughout this final determination as the NER model data provision framework).

The NER also set out arrangements for registered participants to access some of this information, in the form of encrypted model data, where reasonably required, to perform power system studies (referred to throughout this final determination as the standing data framework).[3]

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2 Models are mathematical representations of how particular equipment, such as a generating unit or network equipment, will function under different conditions. They are used as inputs to broader modelling studies of the power system (known as power system studies), which allow parties to examine how the power system will function under a range of different conditions. These power system studies are used by generators, AEMO and network service providers to inform a number of processes, including the development of constraint equations, the planning of networks and the development of generator performance standards.

3 Throughout this document, the term model data is the general term that is used to refer to the information that makes up the different kinds of models of generation and associated equipment, including RMS and EMT type models. For example, an RMS-model, being a particular type of

Both of these frameworks are described below.

Generators are currently required to provide AEMO and network service providers with certain model data when connecting to the electricity grid.

Generators with a combined nameplate rating of 30 MW or more must provide to AEMO, and the relevant network service provider, model data about the control systems of their generating system. This is part of the connection process and includes a requirement for the generator to provide the following information:

- a set of functional block diagrams, including all functions between feedback signals and generating system output
- the parameters of each functional block, including all settings, gains, time, constants, delays, deadbands and limits, and
- the characteristics of non-linear elements,

with sufficient detail for AEMO and the network service providers to perform load flow and dynamic simulation studies.[4]

In addition, AEMO or the relevant network service provider can request a generator to provide an update to this information after the generator is connected if AEMO or the relevant network service provider considers that the information is incomplete, inaccurate or out of date.[5]

Generators are required to provide certain model data to the relevant network service provider and AEMO when proposing to alter a connected generating system, or a generating system for which performance standards have been previously accepted by AEMO, if the alteration will affect the performance of the generating system relative to any of the technical requirements set out in clauses S5.2.5, S5.2.6, S5.2.7 and S5.2.8.[6]

Generators are required to provide model data to AEMO in both an encrypted and a non-encrypted format.[7]

The NER also set out high level requirements for ancillary service providers to provide AEMO with certain modelling data. Specifically, prospective providers of system restart ancillary services (SRAS) are required to provide to AEMO data, models and parameters of relevant plant, sufficient to facilitate a thorough assessment of the network impacts and power station impacts of the use of the relevant system restart ancillary service.[8]

Parties tendering to provide network support and control ancillary services (NSCAS) are required to provide to AEMO data, models and parameters of relevant plant,

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mathematical representation of a generator and related equipment, consists of a defined set of model data information.

4 See clause S5.2.4(b)(5) of the NER.

5 See clause S5.2.4(d)(3) of the NER.

6 See clause 5.3.9 of the NER.

7 See clause S5.2.4(b)(6) of the NER.

8 See clause 3.11.9(g) of the NER.

sufficient to facilitate a thorough assessment of the network impacts and power station impacts of the use of the relevant network support and control ancillary service.[9]

There is also a requirement for generators that connect generating units equal to or less than 30MW to a connection point to a distribution network to provide certain data, but this will usually be less than is indicated in the guidelines and data sheets, but other data must be provided if reasonably required by the network service provider or AEMO.[10]

Under the standing data framework in clause 3.13.3 of the NER, a registered participant may request certain data and information from AEMO. For example, this may include the encrypted model data previously submitted to AEMO,[11] where that information is reasonably required by the registered participant to carry out their own power system studies.[12] Any information provided to a registered participant by AEMO under that framework must be treated as confidential information.[13]

1.3 Rationale for the rule change request

In its rule change request, AEMO stated that changes in the power system, particularly a reduction in system strength in some areas,[14] mean that more detailed power system studies are required to understand how the power system will function under certain conditions.[15] These more detailed studies require more detailed model data as an input.

AEMO argued that the current NER model data provision framework does not necessarily allow it to obtain the kind of model data needed to undertake these more detailed power system studies.

AEMO stated that the NER currently:

- require generators to submit data necessary for AEMO (and relevant network service providers) to perform load flow and dynamic power system studies. However, as the type of model data to be provided is not specified, generators may not provide model data at the level of detail required by AEMO to undertake effective studies of the power system. To date, generators have submitted simpler root mean square (RMS) type model data, rather than more detailed electromagnetic transient (EMT) type model data. EMT and RMS-type model data is discussed in Box 1.1 below. AEMO stated that this RMS-type model data may no longer provide a level of detail sufficient to undertake effective power system

9 See clause 3.11.5(b)(5) of the NER.

10 See clause S5.5.6 of the NER.

11 For example, the encrypted model data previously provided by generators as part of their connection process under S5.2.4(b)(5) of the NER.

12 See clause 3.13.3(k) of the NER.

13 See clause 3.13.3(l)(3) and rule 8.6 of the NER.

14 See section 3.1.3

15 AEMO, rule change request, 31 October 2016, pp. 5-6

studies, given changes to the power system such as reduced levels of system strength.[16]

- only require the provision of information related to generating units and do not require the provision of information about other equipment owned by generators, such as generator governors and protection equipment, as well as equipment owned by network service providers, such as static var compensators (SVCs), synchronous condensers or interconnector protection systems. AEMO stated that these kinds of equipment may have a significant impact on the performance of the transmission network.[17]
- require parties tendering for ancillary services including NSCAS and SRAS to provide data and models to AEMO for the purposes of assessing the effectiveness of the tendered ancillary services. However, AEMO argued that the type of data generally sought under those provisions may not be sufficient to allow for the most effective assessment of ancillary service tenders, which may result in inefficient under or over procurement, or the procurement of services that may not work effectively or as intended.[18]

Box 1.1 AECOM advice: RMS and EMT models

Given the technical complexity of some of the issues contained in the rule change request, the Commission sought independent advice from AECOM, a firm with technical experience in the development and assessment of model data and power system studies.

AECOM provided advice to the AEMC in regards to a number of issues. This included advice in relation to the following topics:[19]

- the cost of development of EMT-type models as opposed to RMS models
- confidentiality and encryption related issues associated with sharing of EMT-type models with third parties
- a review of international requirements around EMT-type models
- experiences with projects in the NEM requiring EMT-type models.

The findings of the report prepared by AECOM are reflected and referenced throughout this final determination.

For the purpose of power system studies, there are two types of model data that can be used: RMS-type (root mean square) and EMT-type (electromagnetic transient) models:

- RMS-type models are easier to develop and are less complex, but may also be less accurate and not provide an adequate representation of power

16 AEMO, rule change request, 31 October 2016, pp. 5-6

17 AEMO, rule change request, 31 October 2016, p. 4

18 AEMO, rule change request, 31 October 2016, p. 6

19 AECOM, EMT and RMS model requirements, 23 May 2017. A copy of AECOM's report is available at www.aemc.gov.au

system outcomes in more extreme circumstances such as when the system strength is low or when modelling high frequency phenomena such as lightning and switching studies.

- EMT-type models are typically more complex and can be more detailed than RMS-type models. They can also provide a more realistic representation of power system operation under more extreme circumstances. However, EMT-type models may also be more costly and difficult to prepare than RMS-type models. EMT based power system studies are also significantly more complex and time consuming than equivalent RMS studies.
- We have been advised by some stakeholders that EMT-type models could also be potentially more commercially sensitive, as they provide a more detailed representation of how a generating unit and related systems operate. However, advice from AECOM suggests that "black boxing" and encryption can provide adequate protection for sensitive data.

RMS-type models provide a more simplified representation of how certain elements within the power system operate. In most cases, RMS-type models represent the voltages and currents variables in the power system as balanced 3-phase sine waves with a magnitude and phase angle. The power system elements (such as the lines, transformers, and generators) are approximated by their characteristics at 50 Hz. These approximations dramatically reduce the complexity of the modelling while generally providing sufficiently accurate representations of typical power system operations. RMS-type models have traditionally been fit for purpose in assessing systems dominated by synchronous generation and have traditionally been the main form of model used in the NEM by AEMO, network service providers and market participants when undertaking power system studies..

However, RMS-type models are not always capable of accurately modelling non-synchronous generating systems and how such equipment may interact with each other when there is low system strength. In addition, RMS models may not be fully effective for use in modelling the power system under more extreme conditions, such as during system restoration, where frequency and voltage may be well outside normal limits.

EMT-type models are able to provide more precise predictions of how the power system is likely to react in various situations. Unlike RMS-type models, EMT-type models provide the means to simultaneously and accurately assess all three phases in the power system. RMS-type models are only capable of modelling three phases to the extent that they can be represented by sine waves.

EMT-type models represent the power system voltages and currents in the individual phases as time series. Similarly, the power system elements are represented by differential equations with a much finer time resolution. This approach better represents the actual operation of power system elements and is necessary when modelling the complex interactions with inverter based generating systems, particularly when the fault level (or system strength) is low.

They are also better at representing the fast acting control and protection systems of non-synchronous generation that would not otherwise be captured by standard RMS-type power system studies. Historically, it has not been necessary to use EMT models for NEM power system studies. However stakeholders have advised that recently, EMT models have been used in the development of generator performance standards for the connection of specific generating units.

1.4 Solution proposed in the rule change request

To address this issue, AEMO's proposed rule set out a number of changes to the existing NER model data provision framework, including:

- Broadening the "scope" of the model data to be provided to AEMO, by expanding the NER model data provision framework to apply to a broader range of participants and relevant plant and equipment.
- Increasing the level of detail of the model data to be provided to AEMO, by specifying in the NER model data provision framework under which generators would be required to provide EMT model data under specific conditions or where this was deemed necessary by AEMO.

1.4.1 Extended detail and scope of data provision

AEMO stated that allowing it to gather model data in relation to a broader range of plant and equipment, as well as more detailed model data, will allow it and network service providers to undertake more effective power system modelling. This would allow for improved power system operation in the context of changing power system conditions, particularly reduced power system strength.

AEMO's request for the ability to obtain additional modelling data can be described in terms of both a broader scope, and an increased level of detail. That is:

- a broader scope of model data means having access to modelling information for additional types of generator and network equipment and from additional types of registered participants.
- an increased level of detail means having access to more detail model information about the technical operation of generating and protection equipment, typically through the provision of more detailed EMT type models.[20]

Scope of information to be provided

AEMO recommended that model data requirements in the rules should be extended to include all critical network elements and other generation equipment.

To achieve this, the proposed rule amended the relevant NER references to "Generating System" to "Power System". For example, the proposed rule altered NER clause S5.5.7, which currently refers to Generating System Design Data Sheet, Generating System Setting Data Sheet and Generating System Model Guidelines, to refer to Power System

20 The difference between RMS and EMT models is explained in section 3.1.

Design Data Sheet, Power System Setting Data Sheet and Power System Model Guidelines.[21]

The general effect of this change would be to broaden the scope of information that AEMO would be able to obtain from a range of participants under those documents. This may include obtaining model data that reflects other equipment owned by generators, such as governors and protection equipment, or equipment necessary for the provision of ancillary services. It also expanded the scope of information to include model data for equipment owned by network service providers, which could include interconnector protection systems, static var compensators (SVCs) and synchronous condensers.

Detail of information to be provided

The proposed rule required generators with a nameplate rating of 30MW or more to provide to AEMO, in defined cases, all data required to perform specialised power system studies based on electromagnetic transient simulation analysis (EMT-type model data).

The proposed rule required this model data to be provided to AEMO where a generating system was connected to the network via power electronic interfaced technologies:

- at the transmission system level, or
- at the distribution system level if the installed capacity of the plant is greater than 10% of the available fault level at that point of connection, or
- in AEMO's reasonable opinion, there is a risk that the generating system will adversely affect other network users, power system security, or quality or reliability of supply of the power system.[22]

As such, AEMO proposed that it would have discretion to require generators to provide EMT model data in certain circumstances, which would be assessed based on the risk that the equipment will adversely affect network capability, power system security, quality or reliability of supply, inter-regional power transfers or the use of a network by another network user.

In its rule change request, AEMO stated that when deciding whether to require such modelling data, AEMO would consider, among other factors, "the size of the plant, connection point specifications, and the presence of adjacent plant", although this consideration was not set out in the proposed rule itself.[23]

1.4.2 Stated benefits of increased model data detail and scope

AEMO stated that requiring participants to provide it with more detailed and a broader scope of model data will allow it to operate and plan the power system more effectively:

- **More effective connection processes:** AEMO considered that more detailed model data will assist in the assessment of new generators seeking to connect to

21 AEMO, rule change request, 31 October 2016 p. 30

22 Ibid., p. 7

23 Ibid., p. 7

the power system. For example, more detailed EMT-type models would allow AEMO (and potentially network service providers) to more effectively assess how non-synchronous, power electronic connected generators are likely to behave in a low power system strength environment, including how they may interact with other generators.[24] This would allow for the negotiation of more effective access standards.[25]

- **More effective power system operation:** AEMO considered that it could conduct better power system studies if it had access to more detailed modelling data. This would allow for the formulation of more accurate constraint equations to support more efficient operation of the power system.[26] AEMO stated that more accurate power system studies would also allow for the efficient procurement of more effective ancillary services, supporting the secure operation of the power system.[27]
- **More effective planning processes:** AEMO advised that building extra transmission network capacity that cannot be fully utilised in practice could be avoided through more detailed model information to enable more accurate power system studies. This is because the effective utilisation of network capacity may be impacted due to the characteristics of non-synchronous generation. More detailed EMT-type model data to support better power system studies throughout the planning process may allow for these limitations to be identified before they arise. AEMO stated that more detailed model data would assist the evaluation of options presented during regulatory investment tests for transmission (RIT-T) by allowing for the higher integration of intermittent generation, while maintaining power system security.[28]

AEMO stated that increasing the level of model data for evaluating tenders of NSCAS and SRAS will allow it to undertake more effective assessments of both market and non-market ancillary services.[29] This may have benefits in terms of improving the efficiency of service procurement, as well as allowing for more efficient operation of the power system.

AEMO stated that a broader scope and more detailed model data from parties seeking to tender for ancillary services would allow for more accurate assessment of how the ancillary service would function in extreme power system conditions.[30]

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24 Ibid., p. 15

25 Access standards are approved by the relevant network service providers , however, in accordance with clause 5.3.4A of the NER, the NSP must consult with AEMO on those proposed negotiated access standards that are AEMO advisory matters.

26 AEMO, rule change request, 31 October 2016, p. 15

27 Ibid., p. 6

28 Ibid., p. 7

29 Market ancillary services include regulation and contingency FCAS and are sourced by the NEM dispatch engine through the 5 minute dispatch process. Non-market ancillary services include SRAS and NSCAS. SRAS is procured by AEMO and NSCAS is procured by network service providers, with AEMO procuring NSCAS where it identifies an "NSCAS gap" in network service providers' procurement. Both SRAS and NSCAS are typically procured on a bilateral contract basis.

30 Ibid., p. 6

By allowing for more accurate modelling of tendered services, AEMO stated it may be better positioned to procure an efficient quantity of the relevant service, avoiding unnecessary purchases and therefore minimising ancillary services costs, which are ultimately borne by consumers through electricity prices.[31]

AEMO also stated that system security may be supported by allowing it to more accurately model the ability of different tendered services to actually deliver their stated capability. In the case of a service like SRAS, this may improve overall system security, by allowing AEMO to procure the services that have the greatest probability of actually being available when called on during a system security event.

1.4.3 Application to existing participants

AEMO's rule change request proposed that generators, network service providers or other registered participants operating power system equipment referred to in the rule change request would be exempt from having to provide information for existing plant unless in AEMO's reasonable opinion there is a risk that the plant will adversely affect network capability, power system security, quality or reliability of supply, inter-regional power transfers or the use of a network by another network user.[32]

As such, in some instances, existing registered participants would be required to provide modelling information. This would mean that, in some cases, AEMO would have some discretion in determining whether additional information, potentially including both a broader scope and more detailed model data, would be required from existing registered participants.

1.5 The rule making process

On 15 March 2017, the Commission published a notice advising of its commencement of the rule making process and consultation in respect of the rule change request.[33] A consultation paper identifying specific issues for consultation was also published. The Commission received 13 submissions. Issues raised in these submissions were summarised and responded to in the draft rule determination. Issues that were not discussed in the body of draft rule determination were summarised and responded to in Appendix A.1.

On 20 June 2017, the Commission published a draft rule determination and draft rule.[34] Submissions on the draft rule determination closed on 1 August 2017. The Commission received ten submissions on the draft rule determination.

The Commission considered all issues raised by stakeholders in submissions. Issues raised in submissions are discussed and responded to throughout this final rule determination. Issues that are not discussed in the body of this document have been summarised and responded to in Appendix A.2.

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31 Ibid., pp. 6, 8

32 Ibid., p. 13

33 This notice was published under section 95 of the National Electricity Law (NEL)

34 The draft rule determination was published under section 99 of the NEL.

2 Final rule determination

The Commission has decided to make a final rule that addresses the issues proposed by AEMO.

The Commission considers that there are likely to be net benefits associated with requiring participants to provide additional or more detailed model data, in certain circumstances.

The final rule seeks to:

- use the existing NER model data provision framework but expands that framework to apply to additional market participants, and imposes principles on AEMO in undertaking its obligations in relation to the further development and implementation of that framework;
- maintain an appropriate level of detail with respect to obligations that are set out in the NER, which are developed by the AEMC, and the obligations that are set out in the generating (power) system model guidelines, generating (power) system design data sheet, and the generating (power) system setting data sheet, which are developed by AEMO.[35]

The final rule amends the existing NER model data provision framework to expand the range of participants that must provide model data to AEMO and, where relevant, network service providers.

The final rule establishes principles that AEMO must have regard to when developing and amending the guidelines and data sheets, with a view to minimising costs and protecting the confidentiality of information, as well as having regard to the requirements of distribution and transmission network service providers necessary to fulfil their obligations.

The final rule requires the more detailed aspects of what types of model data must be provided by parties, and the circumstances of when it must be provided, to be set out in the guidelines and data sheets that are redeveloped by AEMO through the public rules consultation procedure.

Under the proposed rule, AEMO suggested amending the NER to include a specific provision that required the provision of EMT-type model data under specific conditions. In its rule change request AEMO proposed a "limited retrospectivity" approach for existing registered participants.[36] Under this approach AEMO would have had a relatively substantial amount of discretion to request EMT-type model data, with little guidance or transparency for participants as to the more precise conditions in which this data would be requested.

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35 This final rule changes the existing definition of the Generating System Model Guidelines, to the Power System Model Guidelines. The Commission has generally referred to this document as "the guidelines" throughout this determination. The existing definition of Generating System Design Data Sheet and Generating System Setting Data Sheet is also changed to Power System Design Data Sheet and Power System Setting Data Sheet respectively. The Commission has generally referred to these documents as "the data sheets" throughout this determination

36 AEMO, rule change request, 31 October 2016, p. 13

The Commission considers that the approach it has taken in the final rule will enable AEMO (and where relevant, network service providers) to receive the model data needed to maintain power system security. However, it also provides the market with greater clarity and predictability about the relevant model data provision obligations by requiring AEMO to specify the necessary details in the guidelines and data sheets. This clarity will help participants to plan for and manage the potential costs associated with providing more detailed or additional model data.

The final rule has been designed to strike an appropriate balance between including requirements in the NER and clearly setting out the responsibilities of parties, including the technically specific and more detailed operational aspects of market function to be included in the guidelines and data sheets prepared by AEMO.

This balance allows for:

- flexibility to allow for changes in market conditions. Changes to the guidelines and data sheets can be made at AEMO's initiation or upon a person's request, subject to the rules consultation process.[37] This allows them to be adapted as needed, without the need for a rule change process.
- accountability and transparency. The rules consultation process will allow participants to provide input to AEMO's development of the revised guidelines and data sheets, as well as any subsequent amendments. This will deliver a transparent and accountable process.
- recognition of relative areas of expertise. AEMO remains the appropriate organisation to be making decisions regarding technical, operational matters such as the form and content of model data. Subject to the principles and obligations imposed on it by the NER, AEMO is best placed to determine what model data requirements are needed in a changing power system environment.

This chapter sets out the assessment framework that the Commission used in making its final rule, and provides an explanation of the key differences between its draft and final rule, and AEMO's proposed rule.

Chapter 3 provides a more detailed explanation of the Commission's reasoning.

2.1 The Commission's final rule determination

The Commission's final rule determination is to make a final rule, which reflects the issues raised in AEMO's proposal. The key features of the final rule, as summarised below, are consistent with the intention put forward in the rule change request. However, the final rule contains a greater level of detail to give effect to these proposals, while retaining AEMO's overall approach to the issues.

The final rule made by the Commission is attached to and published with this final rule determination. A more detailed overview of the final rule is provided in section 2.4.

The key features of the final rule are summarised below. The final rule:

- broadens the scope of the NER model data provision framework to include non-generating system power system components, such that the model data

37 See rule 8.9 and clause S5.5.7(d) and (e) of the NER.

framework applies to the power system more broadly, as well as the procurement of ancillary services, rather than simply to generating systems

- outlines the content requirements for the guidelines and data sheets
- sets out three principles that AEMO must have regard to when developing and amending the guidelines and data sheets, which are:
    - the reasonable costs of efficient compliance by registered participants with those guidelines and data sheets compared to the likely benefits from the use of the information provided under the guidelines and data sheets
    - any requirements to protect the intellectual property and confidential information of third parties, including where those third parties are not registered participants, and
    - distribution network service providers' and transmission network service providers' requirements for data and modelling information that is reasonably necessary for the relevant provider to fulfil its obligations under the NER or jurisdictional electricity legislation
- requires the provision of model data from any generators, certain network users (customers), market network service providers, transmission and distribution network service providers:
    - at the time of negotiating a new connection to the electricity network
    - when alterations or additions are proposed to existing connected generating systems or the other plant or equipment
    - when surrounding power system conditions have changed, such that older model data no longer remains adequate, such as where there has been a significant reduction in system strength

  in accordance with the circumstances set out in the NER and the guidelines.
- requires the provision of model data from existing generators, network users (customers), market network service providers, transmission and distribution network service providers if network service providers need additional information to assess to assess the impact of a new connecting generator or market network service provider on system strength.
- requires the provision of modelling data and information from tenderers of NSCAS and prospective SRAS providers in the circumstances set out in the NER and the guidelines
- makes clear that AEMO is not required to respond to a relevant network service provider in respect of any AEMO advisory matter until it has received all information required for that assessment from the relevant connection applicant
- makes clear that a relevant network service provider is not required to accept or reject a proposed negotiated access standard from a connection applicant until it has received all information required for that assessment from the relevant connection applicant

- requires AEMO to develop and publish the revised guidelines and data sheets by 1 July 2018, in accordance with the rules consultation procedure under rule 8.9 of the NER.

Having regard to the issues raised in the rule change request and during consultation, the Commission is satisfied that the rule will, or is likely to, contribute to the achievement of the NEO.

The Commission's reasons for making this final determination are set out in section 2.3.

This chapter outlines:

- the rule making test for changes to the NER
- the assessment framework for considering the rule change request, and
- the Commission's consideration of the final rule against the national electricity objective (NEO).

Further information on the legal requirements for making this final rule determination is set out in Appendix B.

2.2 Rule making test

2.2.1 Achieving the national electricity objective

Under the NEL the Commission may only make a rule if it is satisfied that the rule will, or is likely to, contribute to the achievement of the national electricity objective (NEO).[38] This is the decision making framework that the Commission must apply.

The NEO is:[39]

> "to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to:
>
> (a) price, quality, safety, reliability and security of supply of electricity; and
>
> (b) the reliability, safety and security of the national electricity system"

The framework used for assessing whether the proposed rule will, or is likely to, contribute to the achievement of the NEO is set out in section 2.3.

2.2.3 Northern Territory legislative considerations

From 1 July 2016, the Commission assumed rule making responsibility for parts of the NER adopted by the Northern Territory.[40] Some aspects of the proposed rule relate to

38 Section 88 of the NEL.

39 Section 7 of the NEL.

40 See http://www.aemc.gov.au/Energy-Rules/National-electricity-rules/National-Electricity-Rules-(Northern-Territory) for details about parts of the NER adopted by the Northern Territory.

parts of the NER that apply in the Northern Territory,[41] the Commission is required to assess the proposed rule against additional elements required by the Northern Territory legislation.[42]

The *National Electricity (Northern Territory) (National Uniform Legislation) Act 2015* allows for an expanded definition of the national electricity system in the context of the application of the NEO to NER made in respect of the Northern Territory. The Commission must regard the reference in the NEO to the "national electricity system" as a reference to whichever of the following the Commission considers appropriate in the circumstances having regard to the nature, scope or operation of the proposed rule:

(a) the national electricity system

(b) one or more, or all, of the local electricity systems

(c) all the electricity systems referred to above.

Under the Northern Territory legislation adopting the NEL, the Commission may make a differential rule if, having regard to any relevant MCE statement of policy principles, a different rule will, or is likely to, better contribute to the achievement of the NEO than a uniform rule. A differential rule is a rule that:

(a) varies in its term as between:

  (i) the national electricity system; and

  (ii) one or more, or all, of the local electricity systems; or

(b) does not have effect with respect to one or more of those systems,

but is not a jurisdictional derogation, participant derogation or rule that has effect with respect to an adoptive jurisdiction for the purpose of section 91(8) of the NEL.

The Commission has considered whether a differential rule is required for the Northern Territory electricity service providers and concluded that it is not required in this instance. This is discussed further in Appendix B.

2.3 Assessment framework and summary of reasons

This section sets out how the Commission assessed whether the proposed rule will, or is likely to, contribute to the achievement of the NEO. This assessment framework is consistent with that set out in chapter 4 of the consultation paper on this rule change request, and in section 2.3 of the draft determination.

The rule change request sought to amend those aspects of the NER that relate to the provision of modelling information. The Commission developed an assessment framework to address the scope of issues. In assessing the rule change request against the NEO, the Commission considered whether the proposed rule was likely to deliver more efficient outcomes.

41 The final rule amends Chapter 10 of the NER and makes amendments to Chapter 5, which applies in the Northern Territory. The other amendments made in the final rule are to parts of the NER that do not apply in the Northern Territory.

42 *National Electricity (Northern Territory) (National Uniform Legislation) Act 2015*

In particular, the Commission's assessment included consideration of whether the rule change request was likely to facilitate more efficient investment and operation of the power system.

In assessing the rule change request, the Commission considered the extent to which it was likely to lead to more efficient operational and investment outcomes in the NEM.

- **Efficient operation:** The rule change request was assessed in terms of whether the provision of more detailed model data to AEMO and network service providers was likely to enable a better understanding of how the power system can be expected to operate under a range of conditions. This included consideration of whether this better understanding would facilitate more efficient operation of electricity services, primarily through the extent to which it would support more effective power system operation and efficient procurement of more effective ancillary services.
- **Efficient investment:** The Commission also considered the extent to which the provision of more detailed model data was likely to support more effective planning and efficient investment in network and generation assets, particularly in terms of whether it would allow for integration of a greater range of generating technologies, including non-synchronous generation.

The Commission considered these potential operational and investment benefits in light of whether the proposed rule represented a proportional solution to the identified issue, the extent of potential improvements in the security of power system operation and the efficiency of planning processes and price impacts.

Having regard to the issues raised in the rule change request, the Commission is satisfied that its final rule will, or is likely to, contribute to the achievement of the NEO by:

- Supporting efficient operation and security of the NEM, by allowing access to more accurate model data to support more effective power system studies. These more accurate studies will in turn allow for a better understanding of the state of power system, including whether or not the system is likely to be secure under specific conditions. This will enable more effective power system operation and procurement of ancillary services, to support a more secure power system.
- Supporting efficient investment in the NEM, by allowing for more accurate power system studies to support long term network and generation asset utilisation planning. Better long term planning will support more efficient investment outcomes by allowing for effective integration of a greater range of generating technologies in the future.

In assessing the rule change request and developing the final rule, the Commission has considered:

- the proportionality of the solutions developed in the final rule, relative to the materiality of the issue identified
- the potential power system operational benefits associated with the final rule
- potential beneficial outcomes in regards to more efficient planning

- impacts on consumer prices.

2.3.1 Proportionality

When considering the introduction of new regulatory requirements for modelling data provision, it is first necessary to consider the materiality of current issues, whether they can be adequately addressed under the existing NER model data provision framework or whether changes to the NER are required.

In assessing the proposed rule, the Commission considered whether introduction of more regulatory obligations for the provision of a wider scope and greater level of detail of model data would result in higher implementation and compliance costs, and whether these costs were commensurate and proportionate to the materiality of the issue it is designed to address.

As discussed in Chapter 3, the Commission considers that its final rule strikes the appropriate balance between the materiality of the issue identified by AEMO and the costs associated with the provision of additional model data.

While there may be some costs faced by participants when providing more detailed or additional model data, the Commission considers that these costs are outweighed by the overall operational, investment and security benefits enabled by the final rule. Furthermore, the final rule establishes a number of measures that the Commission considers will be effective in helping to minimise the extent of any costs for participants.

2.3.2 Operation of the power system

In assessing the proposed rule, the Commission considered the extent to which the provision of more detailed model data would support efficient power system operation and support power system security.

Power system security refers to the safe scheduling, operation and control of the power system within certain technical operating limits. The Commission is of the view that provision of a broader scope and more detailed modelling data to AEMO would allow AEMO to undertake more effective power system studies. This would in turn enhance the quality of the system information available to AEMO and allow for more effective power system operation, helping to improve the overall security of the power system.

The Commission considers that access to more detailed and a broader scope of modelling information would also allow AEMO to undertake more effective assessments when procuring various ancillary services. These services are used to support the secure operation of the power system and also to restore the power system to a secure state following emergency events. More effective ancillary service procurement would therefore support more effective management of system security issues as they arise.

2.3.3 Planning outcomes

The Commission considered whether access to more detailed modelling data to develop more effective power system studies would support AEMO, network service providers and generators in undertaking their various planning processes.

In this context, planning includes the general processes followed by generators when deciding where and how to connect a new generator to the power system. It also includes the more formal planning processes undertaken by AEMO and network service providers when planning the distribution and transmission networks, through the national transmission network development plan (NTNDP) and annual planning report process.

In the context of the formal planning processes of AEMO and network service providers, the Commission considers that as part of these processes, access to better model data would support more effective power system studies, which could in turn be used when undertaking formal planning obligations through the NTNDP and network service providers' annual planning reports.[43] A more efficient planning process has a number of benefits for consumers, including lower network costs as well as improved system security and reliability outcomes.

This outcome can only be achieved if key system parameters can be accurately modelled and evaluated in the planning phase. The Commission considers that the final rule is likely to support more accurate or effective modelling by AEMO and network service providers, and is therefore likely to enhance the network planning process.

Where planning extends to connecting a registered participant, the Commission considered that where this process is better informed through more detailed model data and more accurate power system studies, AEMO, network service providers and registered participants may be better able to identify the optimal location of their plant in the network.

2.3.4 Costs and price impacts for consumers

There are potential costs to generators and network service providers associated with the provision of additional or more detailed model data. These may be passed through to consumers through increased energy prices or network charges.

However, as discussed above, more efficient planning and operation of the power system may enhance the ability of generators to deliver energy to market, supporting competition in the wholesale market. This may help to constrain price impacts on consumers.

More efficient and effective procurement of ancillary services may also help to reduce the cost of these services, which are ultimately passed on to consumers. This may also result in lower energy prices for consumers.

The Commission's assessment of the rule change request therefore considered these various costs and subsequent price impacts for consumers. As discussed in Chapter 3, the Commission considers that while the final rule may impose some additional costs on participants, there are likely to be net benefits for consumers. Furthermore, the final rule establishes a framework that the Commission considers will provide predictability

43 For example, Part B of Chapter 5 of the NER sets out planning and reporting requirements for network service providers. Under these requirements, a NSP is to undertake an annual planning review to identify emerging network constraints expected to arise over a ten-year planning horizon. The results of a review are then published in an annual planning report, which must (amongst other things) set out what the NSP is doing to meet its reliability standards.

around the magnitude of these potential costs, which will help participants to effectively plan for, and minimise, the extent of those costs.

2.4 The Commission's final rule

Having considered the rule change request against the assessment framework set out in section 2.3, the Commission has decided to make a final rule. The final rule is published alongside this final determination.[44] This section describes the final rule.

The final rule:

- expands the range of participants that are required to provide model data
- clarifies and expands the circumstances in which model data is to be provided by participants
- introduces principles that AEMO must consider when developing and amending the guidelines and data sheets
- requires the guidelines and data sheets to include specific matters

These changes are further explained below.

The final rule requires AEMO to develop and publish the revised guidelines and data sheets by 1 July 2018. AEMO must develop the revised Power System Model Guidelines, the Power System Design Data Sheet and the Power System Setting Data Sheet in accordance with the rules consultation procedures under rule 8.9 of the NER.

2.4.1 Expanded range of participants

The final rule expands the range of participants that are required to provide model data. The final rule now expands the scope of the NER model data provision framework so that it explicitly applies to generators (above and below 30MW), distribution and transmission network service providers, NSCAS tenderers, prospective SRAS providers, market network service providers and certain network users (customers).[45]

More specifically, the final rule substitutes Generating System Model Guidelines with Power System Model Guidelines, and substitutes Generating System Design Data Sheet and Generating System Setting Data Sheet with Power System Design Data Sheet and Power System Setting Data Sheet throughout the NER.

This has the effect of broadening the scope of the guidelines to cover non-generating systems, and therefore now applies to other types of plant that is operated by other types of participants. Specifically, the range of participants and plant covered by the guidelines includes:

- **Network service providers:** the final rule requires network service providers to provide information and model data to AEMO (and any other relevant network

44 The final rule is available on the AEMC's website at: http://www.aemc.gov.au/Rule-Changes/Generating-System-Model-Guidelines

45 The NER model data provision requirements applies to those network users to which Schedule 5.3 of the NER applies to, being first-tier customers, second-tier customers, market customers and non-registered customers.

service provider)[46] in accordance with the requirements described in clauses 4.3.4(n), 5.2.3(j) and (o) of the final rule.

- **Market network service providers:** the final rule requires market network service providers to provide information and model data to AEMO and the relevant network service provider(s) in accordance with the requirements described in clauses 5.2.3A(a), (b), and S5.3a.1(a1) of the final rule.
- **Network users:** the final rule requires certain network users to provide information and model data to AEMO and the relevant network service provider(s) in accordance with the requirements described in clauses 5.2.4(c), (d) and S5.3.1(a1) of the final rule. AEMO may exempt certain network users from the requirement to provide some or all of data in the circumstances set out in the guidelines.[47]
- **Generators:** the final rule requires generators to provide model data in accordance with the requirements described in clauses 5.2.5(d), (e), 5.3.9, S5.2.4 and S5.5.6 (for generators less than 30MW) of the final rule.
- **NSCAS providers:** the final rule requires a tenderer for NSCAS to provide sufficient data, models and parameters for relevant plant in accordance with the requirements described in clause 3.11.5(b)(5).
- **SRAS providers:** the final rule requires a prospective SRAS provider to provide to AEMO sufficient data, models and parameters of relevant plant in accordance with the requirements described in clause 3.11.9(g).

2.4.2 Expanded and specified circumstances

The final rule clarifies and expands the circumstances in which AEMO may request model data from registered participants. It specifies that the model data provided must be consistent with the requirements and circumstances established in the guidelines and data sheets.

This includes new provisions that allow AEMO to request an existing connected generator, distribution or transmission network service provider, market network service provider or network user (to which Schedule 5.3 applies) to provide additional or updated model data, where AEMO considers that this is necessary.[48]

The final rule also allows AEMO to request a generator who is proposing to alter a connected generating system to provide additional model data where AEMO considers that the alteration of the generator's plant may have broader impacts on the power system.[49] This must occur in the circumstances as set out in the power system model guidelines.

More specifically, the final rule:

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46 For example, if a DNSP was required to submit information under this clause, the information may also be provided to a TNSP or another DNSP to which that DNSP is connected.

47 See clause S5.3.1(a3) of the final rule.

48 See clauses 5.2.3(j) and (k); 5.2.3A(a) and (b); 5.2.4(c) and (d); 5.2.5(d) and (e) of the final rule.

49 See clause 5.3.9(a) of the final rule.

- substitutes references to load flow and dynamic simulation studies with a broader reference to power system simulation studies.
- clarifies that information is provided about both the control systems and protection systems of equipment[50]
- allows AEMO to ask network service providers, market network service providers, certain network users (customers) and generators to provide to AEMO, and the relevant network service provider(s), modelling information[51] when requested by AEMO because in AEMO's reasonable opinion, there is a risk that the relevant participant's plant will:
    - adversely affect network capability, power system security, quality or reliability of supply, inter-regional power transfer capability,
    - the use of a network by a network user, or
    - have an adverse system strength impact.[52]

  The particular requirements and circumstances are to be specified in the Power System Model Guidelines and the guidelines and data sheets.
- allows AEMO to ask network service providers, market network service providers, certain network users (customers) and generators to provide to AEMO, and the relevant network service provider, modelling information if in AEMO's reasonable opinion such information is required to enable a network service provider to conduct the assessment required by clause 5.3.4B of the NER.[53] Such assessment is required to determine how a new connecting generator or market network service provider will impact system strength.
- allows AEMO to ask for updated model information from a generator where that generator proposes to alter its generating system, even if such an alteration does not affect the performance of the generating system relative to the technical requirements in schedule 5.2.

  That is, AEMO may also require the generator to provide updated information in those circumstances specified in the Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet, where in AEMO's reasonable opinion, there is a risk that the proposed alteration will adversely affect network capability, power system security, quality or reliability of supply,

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50 See clauses 4.3.4(o)(1)(i) and (ii); S5.2.4(b)(5)(i), and (ii); S5.3.1(a1)(1) and (2); S5.3a.1(a1)(1) and (2) of the final rule.

51 This type of information is described in 4.3.4(o), S5.3a.1(a1), S5.3.1(a1) and S5.2.4 of the final rule and it is provided by a network service provider, market network service provider or a customer when it alters or connects any new or additional equipment to the network or by a generator when negotiating its connection agreement.

52 See clauses 5.2.3(j), 5.2.3A(a), 5.2.4(c) and 5.2.5(d), respectively, of the final rule.

53 See clauses 5.2.3(k) 5.2.3A(b) 5.2.4(d) and 5.2.5 (e) of the final rule.[54] See clause 5.3.9(a) and (b) of the final rule. AEMO may also request model data from a generator if there is a risk that the proposed alteration will have an adverse system strength impact, however, this case is addressed in clause 5.3.9(a)(2) of *the Managing power system fault levels* final rule.

inter-regional power transfer capability or the use of a network by another network user.[54]

- allows AEMO to ask for updated model information from a network service provider where that network service provider proposes to alter equipment, or to connect any new or additional equipment to its network, where in AEMO's reasonable opinion, there is a risk that such equipment will adversely affect network capability, power system security, quality or reliability of supply, inter-regional power transfer capability, or the use of a network by a network user.[55]

Information provided under the framework must contain sufficient detail for AEMO (and the relevant network service provider) to perform power system simulation studies in accordance with those requirements and circumstances specified in the guidelines and data sheets.[56]

2.4.3 AEMO guideline principles

The final rule requires AEMO to have regard to three principles when developing and amending the guidelines and data sheets. These principles are intended to limit the costs for participants in providing model data, help network service providers meet their obligations under the NER and jurisdictional electricity legislation, and to protect intellectual property and confidential information.

The final rule requires AEMO, when developing and amending guidelines and data sheets to:

- have regard to the reasonable costs of efficient compliance by registered participants compared to the likely benefits from the use of the information.

  The Commission considers that this obligation will require AEMO to undertake an assessment of the likely costs and benefits associated with requesting additional model data from participants. In undertaking this assessment the Commission expects that AEMO will consider the likely costs that a participant may incur when providing model data, as weighed against the potential system security or operational benefits associated with the provision of that data, and accordingly set out the relevant detailed requirements in the guidelines to reflect this.

- have regard to any requirements to protect the intellectual property and confidential information of third parties.

  The Commission considers that this obligation with help address concerns raised by some stakeholders regarding the confidentiality of information provided to AEMO under the NER model data provision frameworks. In meeting this obligation, the Commission considers that AEMO will consider the various

54 See clause 5.3.9(a) and (b) of the final rule. AEMO may also request model data from a generator if there is a risk that the proposed alteration will have an adverse system strength impact, however, this case is addressed in clause 5.3.9(a)(2) of *the Managing power system fault levels* final rule.

55 See clause 4.3.4(n) of the final rule.

56 See clauses 4.3.4(p), S5.3.1(a2), S5.3a.1(a2), S5.2.4(b1) and S5.2.4(c)(2) of the final rule.

options available to it to protect any confidential or otherwise sensitive information provided to it, including where that information is provided by third parties.

- have regard to transmission and distribution and network service providers' requirements for data and modelling information that is reasonably necessary for them to fulfil their obligations under the NER or jurisdictional electricity legislation.[57]

  The Commission considers that in meeting this requirement, AEMO needs to consider the full range of model data that both transmission network service providers and distribution network service providers are likely to require in executing their various obligations. This may mean including requirements in the guidelines where network service providers need information which may not necessarily be circumstances in which AEMO considers it will need model data. This should help distribution network service providers and transmission network service providers to gain access to information that they need, through the guideline process.

  The Commission expects that in practice, this principle will work in tandem with the specific conditions set out in clauses which describe when AEMO may request additional model data from market network service providers, distribution network service providers, transmission network service providers, generators and certain network users (customers).[58]

2.4.4 Specific matters

The final rule requires AEMO to provide specific detailed and technical information regarding the provision of model data in its guidelines and the data sheets.

This is intended to clarify what type of model data will need to be submitted and by what type of participants under the relevant provisions of the NER. It also sets out a requirement for AEMO to establish defined requirements for information provision. In developing and amending the guidelines and data sheets, AEMO is required to have regard to the purpose of the guidelines and data sheets, which is set out in clause S5.5.7(b). The final rule includes a new purpose of the guidelines and data sheets (from what is currently in the NER), which is to allow plant to be mathematically modelled with sufficient accuracy to permit the efficient procurement of SRAS and NSCAS.[59]

The final rule requires AEMO, when developing, publishing and maintaining the guidelines and data sheets to specify:[60]

- the information, including the types of models, that generators, network service providers, network users, market network service providers, prospective SRAS

57 See clause S5.5.7(c) of the final rule.

58 See clauses 5.2.3(j)(3) and (k); 5.2.3A(a)(3) and (b); 5.2.4(c)(3) and (d); 5.2.5(d)(3) and (e) of the final rule.

59 See clause S5.5.7(b)(1)(iv) of the final rule.

60 See clause S5.5.7(b1) of the final rule.

providers and NSCAS tenderers must provide under each of the relevant provisions in the NER

- the model accuracy requirements that are applicable to each type of model provided to AEMO, as well as the types of generating systems and other plant or equipment that the model accuracy requirements apply to
- when information to which the guidelines relate must be provided
- a process to be followed in circumstances where a person is unable to provide information that is otherwise required to be provided
- guidance on the factors that AEMO will take into account when determining the circumstances under which AEMO will request information to be provided, including the power system conditions that necessitate the usage of a certain type of model in order to achieve the desired level of accuracy,
- the format that information needs to be provided in, and
- the circumstances in which model source code is required to be provided.

The final rule requires registered participants to provide model source code and encrypted models to AEMO, and, where relevant, encrypted models to network service providers.

2.4.4 Confidentiality

The final rule requires AEMO to specify in the guidelines the circumstances in which it will consider model data previously provided to it to be reasonably required by a registered participant, under the standing data framework.[61]

The final rule removes the clause from the draft rule that required AEMO to specify in its guidelines, whether it will treat any of the information submitted to it as confidential information. Confidentiality issues are addressed by the final rule by clarifying that AEMO and network service providers are required to treat the model data received from participants under all of the relevant provisions, as confidential information.[62]

The Commission considers that the protection of confidential model data is better addressed in the NER than in the guidelines, in order to provide clarity for parties that are required to submit model data to AEMO and network service providers as to exactly which types of information is confidential and, therefore, caught by the relevant provisions and obligations on parties .

2.6 How the final rule compares to the draft rule

After consultation with stakeholders following the publication of the draft rule and the draft determination, the Commission considered that further amendments were necessary to reflect the Commission's approach as described at the beginning of Chapter 3.

Some of the key changes from the draft to the final rule included:

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61 See clause 3.13.3(k1) of the final rule.

66 See clauses 4.3.4(q), 5.2.3(l), 5.2.3A(c), 5.2.4(e), 5.2.5(f), S5.3.1(a4) and S5.3a.1(a3) of the final rule.

- a requirement for AEMO to consider the specific needs of transmission and distribution network service providers with regards to receiving model data, where this is needed to fulfil their NER or jurisdictional electricity legislation obligations
- an ability for AEMO to ask network service providers, market network service providers, certain network users, including customers and generators, to provide to AEMO, and the relevant network service provider(s), modelling information when requested by AEMO because in AEMO's reasonable opinion, there is a risk that the relevant participant's plant will:
    - adversely affect network capability, power system security, quality or reliability of supply, inter-regional power transfer capability,
    - the use of a network by a network user, or
    - have an adverse system strength impact.
- removal of the requirement in the draft rule for AEMO to accept model data in multiple software formats, on the basis that this requirement may impose inefficient costs
- specification of AEMO and network service provider obligations to respond during a connection application process, until necessary model data has been provided.

Network service providers' access to data

In the draft rule, the Commission amended the NER model data provision framework to make it clearer as to when AEMO and network service providers are provided with data.

The Commission has further considered the specific need for network service providers, particularly distribution network service providers, to gain access to additional model data from generators and network users, including customers in circumstances where AEMO may not also need that information. For example, additional model data may be required for network service providers in order to meet their minimum fault level obligations.

In addition, there will be new NER obligations on network service providers arising from the *Managing power system fault levels*[63] rule change, to assess the impact of new connecting generators or market network service providers on system strength. Such assessments may necessitate the provision to network service providers of updated, detailed model data of plant owned by existing registered participants located in close proximity to a new connecting participant.

The Commission understands that network service providers may also need access to model data in order to fulfil their various obligations under the NER and jurisdictional electricity legislation arrangements.

Submissions to the draft determination from network service providers therefore argued that network service providers should have the ability to request model data directly from both connecting and existing generators.[64]

63 See AEMC, *Managing power system fault levels*, Final Determination, 19 September 2017

64 ENA, submission to the draft determination, p. 2.

While the Commission acknowledges that network service providers may need access to model data in circumstances where AEMO does not, in order to fulfil certain obligations, the Commission remains of the opinion that AEMO should be the only party in the NEM that is entitled to exercise discretion in requesting updated model data from existing registered participants. In certain cases, transmission and distribution network service providers may legitimately need to gain access to this data. However receipt of this data should be preceded by a request by AEMO. Maintaining AEMO as the party that is able to request this data will not increase the number of parties (including relevant network service providers) that can request additional model data from registered participants, and the related costs they may incur. This issue is discussed further in section. 3.4.4.

In regards to the above, the final rule:

- introduces an obligation on AEMO to have regard, while developing the guidelines and data sheets, to both transmission and distribution network service providers' requirements for model data. This applies to model data that is reasonably necessary for these network service providers to fulfil their obligations under the NER and jurisdictional electricity legislation.

  The Commission considers that in meeting this NER obligation, AEMO will comply with reasonable network service provider requests for updated model data to be provided by relevant parties and include these requirements in the revised guidelines, where it is clear that this is necessary for the network service provider to meet its NER obligations.

- clarifies that different classes of registered participants are required to submit information to the relevant network service provider(s) at the same time it is provided to AEMO, except when it is provided in relation to the provision of NSCAS and SCAS. Information submitted to network service provider(s) does not include model source code in an unencrypted format, as this kind of information is submitted to AEMO only.

- explicitly defines the range of parties, from whom AEMO may request updated model data when it reasonably considers that their plant or equipment will have an adverse system strength impact. The Commission considers that meeting this NER obligation, AEMO will be able to aid network service providers in meeting their system strength related obligations, because AEMO will be able to request information that is required by network service providers for assessing the power system.

enables AEMO to request additional model data from existing registered participants, in cases where network service providers need updated model data to accurately assess how new connecting market network service providers or generators will impact system strength. The Commission considers that by providing the model data, existing participants will help in determining the need to remediate any adverse system strength impact that a new connecting participant may cause. **Acceptable software**

The draft rule introduced an obligation on AEMO to use reasonable endeavours to accept model data in a range of software simulation products and versions. The

purpose of this obligation was to help manage costs for participants, by allowing them to select the software package through which they would provide model data.

Following consultation with stakeholders, the Commission has given further consideration to this requirement. The Commission now considers that the additional costs incurred by AEMO and network service providers in order to be able to accept model data in a range of software packages may outweigh the potential benefits.

The Commission understands that the practical effect of this clause may have caused the increase of costs on an aggregate level in the NEM, because it would have required AEMO and network service providers to maintain and build up the capabilities for running power system simulations on multiple platforms. The costs of this would have been passed on to consumers and registered participants in the NEM.

In addition, the Commission also considers that the conversion of model data from one format to another may compromise the accuracy of the model and may also cause delays.

Furthermore, the final rule includes an obligation on AEMO to have regard to the reasonable costs of efficient compliance by registered participants, compared to the likely benefits from the use of the information when developing the guidelines and data sheets. This requires AEMO to have regard to the costs of compliance when setting out how it will seek additional models from participants, and therefore to consider whether the cost of having that additional information is proportionate to the benefits arising from the use of that additional information.

The Commission considers that in meeting this obligation, AEMO will consider the costs incurred in supporting various software packages and weigh these against potential benefits, such as whether this will support the efficient compliance by participants with the requirements of the guidelines.

The Commission considers that given the general nature of this obligation, more detailed and prescriptive measures are not necessary to limit participant costs.

The final rule therefore removes the explicit requirement on AEMO to use reasonable endeavours to accept a range of software simulation products and versions.

Connection process and negotiated access standards

The draft rule did not address the issue of when model data should be provided by connection applicants to network service providers in relation to the connection applicants' proposed negotiated access standards.

Timely and complete submission of all models and other information required under clause S5.2.4 was raised as an issue by AEMO in its submission to the draft determination.[65]

The Commission understands that AEMO and network service providers' ability to assess proposed negotiated access standards relies on the provision of accurate model data, and therefore, the network service provider and AEMO are not able to properly assess the impact of a proposed negotiated access standard until all required information has been provided by the connection applicant.

65 AEMO, submission to the draft determination, p.4.

Therefore, in order to allow for an accurate and timely review, it is necessary to provide clarity to connection applicants that all required information needs to be provided to AEMO and network service providers before they are able to provide a response.

The final rule therefore makes it clear that AEMO is not required to respond to network service providers in respect of any AEMO advisory matter[66] until it has received all information required for its assessment of the proposed negotiated access standard from the connection applicant.[67] Similarly, the network service provider is not required to respond with its acceptance or rejection of a proposed negotiated access standard until it has received all information required for its assessment of the proposed negotiated access standard from the connection applicant.[68]

Confidentiality of information

The final rule requires AEMO to have regard to the sensitivity of model data when developing the guidelines and data sheets.

The draft rule required AEMO to specify in its guidelines whether it would treat any of the information provided to it under the model data provision framework as confidential information.

The Commission has given further consideration to this issue and considers that the protection of confidential model data is better addressed in the NER than in the guidelines. The Commission considers that including an explicit NER requirement on the recipients of model data, including AEMO and the relevant network service provider to treat that data as confidential, will provide greater clarity for parties that are required to submit model data.

The final rule therefore requires AEMO and network service providers to treat all of the information received under the model data provision framework as confidential information. This requirement has been set out in each relevant provision,[69] and therefore, the final rule removes the requirement that was in the draft rule for AEMO to specify in the guidelines whether AEMO will treat that information as confidential information.

Variation framework and the provision of model source code

The draft rule required registered participants to provide source code when submitting model data, under the provision that this source code could only be provided where it was actually available. This was intended to allow for cases where registered participants are not able to provide EMT-type source code to AEMO.

The Commission further considered that the wording related to the provision of source code "where available" in the draft rule could have been misinterpreted to mean that source code for RMS-type models may not need to be provided to AEMO.[70] The

66 An AEMO advisory matter is defined in clause 5.3.4A(a) of the NER as a matter that relates to AEMO's functions under the NEL and a matter in which AEMO has a role in schedules 5.1a, 5.1, 5.2, 5.3 and 5.3a, being the assessment of negotiated access standards.

67 See clause 5.3.4A(d) of the final rule.

68 See clause 5.3.4A(e) of the final rule.

69 See for example clauses 4.3.4(q), 5.2.3(l), 5.2.3A(c), 5.2.4(e), 5.2.5(f)

70 See for example clause 4.3.4(o)(2) of the final and clause 4.3.4(j)(5) of the draft rule.

Commission considers that this unintended consequence of the drafting could have negative impacts, if it resulted in participants seeking to avoid provision of RMS-type model data source code, under the pretence that it was "not available". The Commission understands that RMS-type model data source code is readily available and is typically already provided by participants.

In any case, the Commission considers that the final rule already requires a process to be included in the guidelines for cases where registered participants are unable to provide model data to AEMO and network service providers, because this model data is genuinely unavailable.

The existing guidelines refer to this process as "variation framework". The framework allows participants to request a waiver from meeting some requirements set out in the guidelines and data sheets, by stating reasons and providing evidence for not being able to meet those requirements. The variation framework may be used by registered participants to apply for an exemption where model data is not available.

The Commission also understands that typically source code for EMT-type model data will not be required by AEMO, however source code for RMS-type data typically would be. However, consistent with the Commission's general approach that AEMO should provide clarity by setting out in the guidelines the circumstances in which different types of model data is required, it should also be required to specify the circumstances in which model data source code is required.

Given the issues described above, the final rule removes the words "where available" from the relevant clauses of the NER and requires registered participants to provide source code, when submitting model data to AEMO. However, the final rule also specifies that AEMO must define in the guidelines the circumstances in which registered participants must provide model source code.

Further clarification on when AEMO may request additional model data

In the draft rule, the Commission amended the NER model data provision framework to make it clearer as to when generators, market network service providers, network service providers and certain network users are required to submit model data to AEMO and, where relevant, network service providers.

In particular, the draft rule also allowed AEMO to request *additional* model data from existing generators, outside of the circumstances of new connection or alteration of existing plant. The intention of this was to allow AEMO to request model data from generators when surrounding power system conditions changed, such that older model data no longer remained adequate for AEMO to assess the impact of their plant on the power system.

However, this ability for AEMO to request additional model data only in these circumstances applied to generators and did not extend to requesting additional model data other participants, such as network service providers or certain network users, including customers.

The Commission has further considered that changing power system conditions, including changes in levels of system strength, may impact AEMO and network service providers' ability to adequately model the power system. In order for these parties to be able to continue to accurately model the power system, they may need access to

additional model data about existing plant. This may include access to additional model data related to plant that belongs to generators, other network service providers, market network service providers and certain network users, including customers.

Accordingly, the Commission has made a number of changes from the draft rule to the final rule, in order to clarify that AEMO may exercise its discretion to request additional model data from a range of registered participants, in addition to generators, specifically network service providers, market network service providers and certain network users, including customers. As per the draft rule, clauses related to the request of additional data from generators, this model data requested from network service providers, market network service providers and network users (customers) once requested by AEMO is then also provided to the relevant network service provider.

The final rule also sets out a range of specific conditions that define when AEMO may exercise its discretion to request additional model data from registered participants. These specific conditions are where, in AEMO's opinion, the generator, network service provider, market network service provider or certain network user (customer) plant in question is likely to adversely affect the network capability, power system security, quality or reliability of supply, inter-regional power transfer capability, or another network user or have an adverse system strength impact. Inclusion of this set of "adverse impact" tests will provide clarity to the market as to when AEMO may request additional model data.

The final rule also enables AEMO to request additional model data from existing registered participants, in cases where network service providers need updated model data to accurately assess how new connecting market network service providers or generators will impact system strength. By providing the model data, existing participants will help determine the need to remediate any adverse system strength impact that a new connecting participant may cause. This is consistent with the policy introduced in the *Managing power system fault levels* rule change.

Improving this clarity in the NER will provide predictability to both AEMO and to participants as to when additional data may be requested.

The final rule therefore expands on the range of participants from whom AEMO may request additional model data, to specifically include network service providers, market network service providers, and certain network users (customers).

2.7 Strategic priority

This rule change request relates to the AEMC's strategic priority relating to market and network arrangements that encourage efficient investment and flexibility. By providing access to a more detailed and broader scope of modelling data, this rule change request is intended to deliver more effective generator connection processes and power system operation and planning processes, together with more efficient ancillary services procurement. Taken together, these improvements are intended to allow for ongoing efficient investment that supports a flexible and resilient electricity system.

3 Assessment of the rule change request

Changing power system conditions will require the provision of more detailed model data, in certain circumstances. This is because changes in the power system, particularly reductions in system strength, mean that existing models may not always provide sufficient detail to support accurate power system studies. The Commission therefore considers that there is a case for allowing AEMO and network service providers to source more detailed model data, in some circumstances.

In developing its final rule, the Commission has considered the potential cost implications for participants associated with providing additional or more detailed model data. While there are likely to be some cost impacts for participants, the Commission considers that the final rule provides clarity around the extent of these obligations. This will help participants to plan for and manage the extent of these costs.

The final rule has been developed with a view to maintaining the appropriate balance between the matters included in the NER and those that are best addressed through AEMO's guidelines and data sheets. In respect of this rule change request, the Commission considers that the NER should establish high level obligations and principles that guide participants and AEMO, while the guidelines and data sheets are the appropriate instrument for the provision of more detailed technical and operational information that is likely to require changes over time.

This chapter summarises the key issues considered by the Commission in developing the final rule. It outlines:

- the materiality of the issue, including the need for more detailed model data in certain power system conditions and the importance of accurate power system modelling
- AEMO's current ability to obtain information, exercise of discretion and the cost implications related to obtaining more detailed model data
- the triggers for information provision, describing the cases when more detailed model data will be provided to AEMO and network service providers
- the range of participants required to provide model data to AEMO and network service providers
- availability of more detailed model data to registered participants.

This chapter also highlights the adjustments to the Commission's approach in the final rule in comparison to the draft rule.

3.1 Materiality of the issue

There is evidence that recently, system strength has been reducing in some parts of the NEM power system. This has been driven by a reduction in synchronous generation, as these units exit the market, or are operating less, and are replaced by new non-synchronous generation that does not contribute as much to system strength.[71]

71 AEMC, System Security Market Frameworks Review, Directions Paper, p.67, 23 March 2017

Traditional models used as inputs to power system studies to assess the behaviour of the power system are becoming less accurate in modelling parts of the power system where there are low levels of system strength, because the interactions between the affected generating systems are becoming more complex.

Less accurate models may lead to the development of less accurate constraint equations, less accurate performance standards and less effective procurement of ancillary services. This may impact on the ability of AEMO to operate the power system and may also have system security effects.

3.1.1 AEMO's view

AEMO stated in its rule change request that as a result of the proliferation of new generation technologies, changes to the power system such as reduced levels of system strength in some areas, mean that more detailed studies are required to understand how the power system will function under certain conditions. AEMO was of the view that traditionally used models are not always adequate as they do not fully cover new and emerging generation technologies.

AEMO added that inadequate modelling of the power system results in inefficient methods to manage the uncertainty in accounting for the impact of new generation on network transfer capability, such as conservative limit calculations or investment in network plant that provides higher than needed network performance.[72]

3.1.2 Stakeholders' submissions to the consultation paper

Many stakeholders agreed in their submissions to the consultation paper that changing power system conditions are impacting on the ability of AEMO and other parties to undertake accurate modelling of the power system.[73] Others, such as Vestas and Siemens Gamesa, however, were of the view that despite the changes in conditions, AEMO should generally be able to accurately model the power system with the models currently provided. However, Vestas acknowledged, "AEMO's needs for requesting more detailed information (EMT model)"[74] and the need for AEMO to require additional model data from existing participants under certain circumstances.[75] Siemens Gamesa noted that in certain grid conditions, EMT-type models would be used.[76]

72 AEMO, rule change request, 31 October 2016, p. 5

73 Alinta submission, 12 April 2017, p. 2, AEMO submission, 12 April 2017 p. 2, DIgSILENT submission, 12 April 2017, pp. 1-2, Energy Networks Australia submission, 12 April 2017, p. 13, ENGIE submission, 12 April 2017, p. 2, Ergon Energy and Energex submission, 12 April 2017, p. 7, Hydro Tasmania submission, 13 April 2017, p. 1

74 Vestas submission, 12 April 2017, p. 6,

75 Ibid., p. 10

76 Siemens Gamesa submission, 12 April 2017, p. 2

3.1.3 Stakeholders' submissions to the draft determination

Stakeholders that commented on the materiality of the issue in their submissions to the draft determination agreed that changing power system conditions necessitate more accurate modelling.

Meridian Energy noted that greater accuracy in AEMO's system studies will lead to a more efficient use of the power system. It suggested that the counterfactual would be a power system with an overly conservative set of constraint equations, which would also have to deal with the inherent uncertainty associated with inefficient modelling outcomes.[77]

ENGIE reiterated its former view that it supports the requirement for AEMO and the NSPs to have access to sufficient modelling data to ensure the ongoing secure operation of the power system. It further noted that as the industry transitions from synchronous generating equipment to new forms of non-synchronous generating plant, it is also clear that the nature of the modelling task is changing, along with the type of data needed.[78]

The Public Interest Advocacy Centre (PIAC) noted that because of the great amount of uncertainty and change in the market at this point in time, it is increasingly important that AEMO has all the information required to do its job as the system operator and national planner.[79]

The Australian Energy Council acknowledged the significant changes in the power system which have occurred recently with the introduction of new non-synchronous generation and the retirement of synchronous generation, and the expected changes as new technologies such as batteries alter the power system characteristics. It was of the view that it is reasonable for AEMO to seek additional information to support its power system management.[80]

Ergon and Energex noted that several original equipment manufacturers (OEMs) have recommended that detailed EMT-type modelling in low system strength networks is required. In subsequent assessments, it has been found that the performance modelled by RMS-type models does not reflect the required model accuracy when compared to EMT-type model recommended by OEMs.[81]

Basslink, on the other hand, noted that AEMO was not able to solve the system weakness issues identified in the rule change request, despite having requested additional information in 2014 and 2015.[82]

77 Meridian submission, 1 August 2017, p. 1

78 ENGIE submission, 2 August 2017, p. 2

79 PIAC submission, 1 August 2017, p. 1

80 Australian Energy Council submission, 1 August 2017, p. 1

81 Ergon and Energex submission, 1 August 2017, p. 6

82 Basslink submission, 28 July 2017, pp. 1-2

3.1.4 Assessment

The Commission considers that changed conditions in the power system warrant the provision of more detailed and broader scope of model data. The Commission considers that there are likely to be specific cases where additional model data is needed for AEMO and network service providers to effectively study the power system and comply with their responsibilities under the NER. This is examined in further detail below.

Decreasing system strength

System strength is a measure of how much the voltage at a connection point varies for a change in the loading or generation at the connection point. System strength is often referred to as the fault level, with a high system strength resulting in a high current if a fault occurs. The system strength is greatest when the connection point is near large synchronous generation and connected via one or more high voltage transmission circuits.

System strength has recently been decreasing in some parts of the power system as a number of traditional synchronous generators are operating less or being decommissioned. In the 2016 National Transmission Network Development Plan, AEMO projected that over the next 20 years there will be a reduction of around 15 GW of synchronous plant in the NEM, while there will be over 22 GW of large-scale inverter-connected generation connected (not including rooftop PV).[83] This displacement of synchronous generation is projected to greatly reduce system strength across the NEM.[84]

An indicator of this decreasing system strength is the short circuit ratio (SCR). This measure is derived by normalising system strength to the size of the generating system at the connection point. SCR may also be referred to as relative system strength. The SCR decreases not only in the case of less synchronous generation present in the system, but also with newly added non-synchronous generation at or near the existing generation. This is because a non-synchronous generating unit in the system increases the denominator of the fraction that represents the SCR, without contributing to the numerator.[85]

The Commission notes advice provided by Ergon and Energex which confirms that reducing system strength is leading to a reduction in SCR values across some parts of the Queensland distribution networks. Ergon and Energex advised that these lower SCR values are likely to have an increasing impact in some network areas, and that this may warrant the use of EMT models to maintain accuracy of power system studies.[86]

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83 AEMO, *National Transmission Network Development Plan*, December 2016, p. 66

84 For a more detailed explanation and discussion on system strength, see AEMC, System Security Market Frameworks Review, Directions Paper 23 March 2017

85 Ibid. p.vi

86 Ergon and Energex submission, 12 April 2017, p.8.

Model accuracy

A generating system's operation is driven by the voltage at the connection point and will operate in an ideal manner if the system strength is high. However, when the system strength is low the operation is affected by the disturbances to the connection point voltage caused by the current injected from the generating system. This interaction between the generating system and the power system can become unstable. In addition, at low system strengths a generating system is unable to continuously operate following a power system fault that affects the connection point voltage.

Power system studies are used to examine these kinds of interactions. Model data that represents various items of generating and network equipment are used as inputs into these power system studies. Traditionally, in power systems with higher levels of system strength, less granular model data, such as provided by RMS-type models, have been sufficient to study these interactions.

However, as system strength reduces, the interactions between the affected generating systems become more complex. This means that these simpler kinds of model data may no longer reflect these interactions accurately, reducing the effectiveness of power system studies.

Using less granular RMS-type models in low system strength environments has been shown to provide less accurate power system studies when used in other jurisdictions. For example, in Texas, a recent study of an area with high penetration of wind generation has shown that lower short circuit levels coincided with material differences in outcomes between power system studies of the same phenomena that used RMS-type as opposed to EMT-type model data. However, the same study found that assuming sufficient system strength, RMS-type models were still useful and quite accurate.

As the short circuit strength drops, these differences are expected to become more pronounced. For general studies in the Panhandle region in Texas, assuming sufficient system strength (e.g. WSCR[87] of at least 1.5 in this case), analysis based on RMS-type models is still useful and quite accurate, although periodic checks are recommended in EMT-type models to validate models and ensure key negative behaviours are caught and understood.[88]

Box 3.1 AECOM advice: the need for EMT models[89]

As part of its advice to the Commission, AECOM undertook some research on the rationale for the use of EMT as opposed to RMS-type model data. AECOM advised that EMT-type models provide more accuracy in comparison with RMS-type ones. Through conversations with various manufacturers, AECOM

87 Weighted Short Circuit Ratio (WSCR) is a metric that is used when multiple generators utilising power electronic converters are connected to the grid in close area proximity to each other. It forms a measure of the system strength in that area. .

88 Anuradha Dissanayaka & Andrew Isaacs, System Strength Assessment of the Panhandle System PSCAD Study, 23 February 2016, p. 41

89 AECOM, EMT and RMS model requirements, 23 May 2017. A copy of AECOM's report is available at www.aemc.gov.au

also found that many manufacturers of non-synchronous generation technologies are of the view that EMT-type models are more accurate than RMS-type models and should be relied upon in any studies.

However, AECOM also advised that EMT-type models do not need to be used in all cases. This is because in certain power system conditions the accuracy of cheaper and simpler RMS-type models do not significantly differ from the accuracy of more expensive and complex EMT-type models. For example the EMT-type model of a synchronous generator under fault conditions and voltage disturbances is likely to behave in a similar manner as an RMS-type model of the same generator.

The requirement for the use of EMT models, in some specific cases, stems from the fact that RMS models are not sufficiently detailed to accurately identify some of the problems associated with integrating inverter connected, non-synchronous generation.

In the context of non-synchronous generation, EMT-type models are able to identify control related interactions, especially under low strength network conditions. Feedback from the original equipment manufacturers regarding model accuracy of non-synchronous generation is that EMT-type models provide the most accurate representation of the generating system. However it isn't clear from the manufacturers' perspective, when EMT-type models should be used and when RMS models should be used given that most studies are currently completed by AEMO in an RMS modelling tool.

AECOM suggested that the following factors have an influence on identifying which type of model should be used:

- strength of the system where the generator is connecting
- the original equipment manufacturer's knowledge and understanding of the suitability of their equipment to operate in a weak network
- availability of accurate models of the wider network as to carry out EMT based assessments and assessment of performance of a generating system is highly dependent on interactions with other generators and/or network equipment.

AECOM has also identified a few international examples where EMT-type models were requested by the system operator.

In Texas, ERCOT used EMT-type models to identify and investigate specific issues related to the interaction of renewable generators with the rest of the power system. Hydro-Quebec in Canada sets out requirements regarding the technical details of what must be included in an EMT-type model. BC Hydro in British Columba also sets out the purposes for which EMT-type models must be provided.[90]

90 Ibid., pp. 14-15

Issues arising from less accurate modelling

The Commission understands that there are a number of potential issues that may arise where less accurate model data is used, resulting in less effective power system studies. These issues include less accurate constraint equations and generator performance standards and less effective procurement of ancillary services.

Constraint equations: Power system studies are used in the development and assessment of the constraint equations that AEMO uses in its operation of the power system. If less accurate power system studies are used in this process, this could result in the development of constraint equations that less accurately reflect the physical limits and requirements of the power system. If these equations are used to manage the power system then it may lead to either:

- a risk that inaccurate constraints lead to insecure operation of the system or
- overly conservative operation of the power system by AEMO to address the risk that its constraint equations are inaccurate.

Performance standards: Generator performance standards are agreed during the process for connection of a generator to the electricity network. They are negotiated between the generator and the network service provider with advice from AEMO on those aspects that are AEMO advisory matters.[91] They may be re-evaluated if there are alterations made to generating system equipment.[92]

The generator performance standards are based on the outcomes of power system studies which assess how a generator will behave in the power system and are verified by testing.[93] If less accurate models are used, this may result in less accurate power system studies because the model may not provide accurate results under more extreme conditions. This may mean that the performance standards may not reflect the actual performance of the generating system, which may lead to unexpected behaviour from generators under certain power system conditions, with implications for power system security.

Ancillary services: Power system studies are also used by AEMO to inform the procurement of ancillary services, including NSCAS and SRAS.

For example, to adequately assess whether a proposed system restart service is likely to work effectively, power system studies are used to examine the extreme voltage conditions that can exist during a system restart event.

The effective procurement and effective use of NSCAS is also dependent on whether these services can actually provide network loading, voltage control and oscillatory stability support, which is tested through power system studies.

Less accurate power system studies may mean that services procured do not actually maintain power system security (i.e. the services are less effective than the simpler modelling indicates). This may also result in economic inefficiencies, as AEMO may

91 See clause 5.3.4A of the NER.

92 See clause 5.3.9(c) of the NER.

93 See rules 5.7 and 5.8 of the NER.

incur additional costs for services that are unlikely to actually deliver enhanced system security.

3.2 AEMO's discretion and ability to obtain information

A key aspect of AEMO's rule change was to expand the range of information that AEMO may request from registered participants, given the importance of having access to such information in certain system conditions. The subsections below describe AEMO's and stakeholders' views on AEMO's current and proposed abilities to obtain such information.

3.2.1 AEMO's view

In its submission, AEMO was of the view that the information gathering powers established under the NEL, as well as the specific model information provision framework in the NER, were not sufficient to allow it to obtain sufficient model data to support effective power system studies.

Specifically, AEMO stated that the information gathering powers in the NEL are "not applicable in the case of the type of information AEMO seeks in this instance, as section 53 of the NEL only applies to a 'relevant function' of AEMO, which does not include the function it performs as power system operator and wholesale market operator under section 49 of the NEL".[94]

AEMO also considered that the existing NER model data framework was not sufficiently specific to allow it to obtain the model data it requires. AEMO's general argument was that the NER was insufficiently specific as to the kind of model data that participants would be required to provide to AEMO, potentially opening up the possibility of disputes with participants as to what model data they should provide.[95]

3.2.2 Stakeholders' submissions to the consultation paper

In their submissions to the consultation paper, most stakeholders indicated that there is no need to further increase AEMO's information gathering powers.

Alinta Energy noted that while it "agrees that changing power system conditions are impacting on the ability of Australian Energy Market Operator (AEMO), and other parties, to undertake detailed modelling of the power system, it does not support the proposal to broaden the scope and increase the level of model data it may request from registered participants."[96] Hydro Tasmania submitted that it "agrees with AEMO that with the increased level of asynchronous plant connected to the power system the existing standard modelling is insufficient on its own to adequately model the power system appropriately." However, it was also concerned, "the proposed rule changes are ambiguous, broad in scope and will potentially significantly increase compliance costs for market participants."[97] A similar view was shared by ENGIE,[98] EnergyAustralia[99]

94 AEMO submission,12 April 2017, p. 4

95 Ibid., p. 4

96 Alinta Energy submission, 12 April 2017, p. 2

97 Hydro Tasmania submission, 13 April 2017, p. 1

Origin Energy,[100] and Vestas.[101] Basslink noted that while the risks of less accurate modelling are "very real", AEMO's rule change addresses the problem in an "extremely inadequate way" in relation to existing participants.[102]

Additionally, many stakeholders were of the view that AEMO's proposed rule would increase AEMO's discretion in an unchecked, unbalanced way that is not desirable. Some suggested that if AEMO was to receive additional modelling data, it would be desirable to set up framework that would spell out transparent conditions around when such models could be requested.

Energy Networks Australia suggested that "appropriate guidance, including reasonable criteria, should be provided to AEMO when seeking such additional modelling data."[103] It further noted that "the guidance should be clear, and ensure that the information is collected on a basis that is consistent, predictable and proportionate given AEMO's requirement."[104] In relation to model data requested from existing participants, Ergon and Energex added, that "there needs to be some guidance and examples as to how AEMO would administer this prospective expanded range of 'discretionary' information requests".[105] Siemens Gamesa did not agree with the general need for more detailed model data, and stated that "AEMO need to be more explicit about what they are studying and more adequately explain in what situations they require an EMT type model".[106]

3.2.3 Stakeholders' submissions to the draft determination

In their submissions to the draft determination, stakeholders generally supported the approach the Commission has taken in the draft determination with regards to clarifying AEMO's ability to obtain information

Meridian submitted that the draft rule strikes the right balance between providing participants and original equipment manufacturers with greater clarity on the requirements introduced by this proposed rule change. It further noted that the Commission's approach strengthens AEMO's power system modelling accuracy levels and capabilities in those areas that are expected to provide a material difference in maintaining a safe, secure, reliable and more affordable 21st century power system. Meridian was also of the view that where AEMO has discretionary powers in respect of requesting additional data from existing registered participants, there are clear

98 ENGIE submission, 12 April 2017, p. 2

99 EnergyAustralia submission, 12 April 2017, p. 1

100 Origin Energy submission, 2 April 2017, p. 1

101 Vestas submission, 12 April 2017, p. 2

102 Basslink submission, 12 April 2017, p. 4

103 Energy Networks Australia submission, 12 April 2017, p. 5

104 Ibid., p. 5

105 Ergon Energy and Energex submission, 12 April 2017, p. 14

106 Siemens Gamesa submission, 12 April 2017, p. 1

conditions in place to guide these requests to ensure efficient and cost effective outcomes for all parties.[107]

ENGIE was supportive of the notion that draft determination requires AEMO to set out guidelines and data sheets which describe the model data and the circumstances under which it will be required.[108]

AEMO noted that the Power System Guidelines will further elaborate the requirements and circumstances where each of the RMS- and EMT-type models will be required.[109] It also added that whether EMT-type models are necessary to study a particular phenomenon will depend on the circumstances and not only on the type of generating units involved.[110]

Ergon and Energex were supportive of the notion that AEMO is required to specify in a set of guidelines the kind of power system modelling data it may request.[111]

However, they were also of the view that the draft rule can be improved to provide greater clarity and transparency to market participants whilst ensuring security and performance of the power system and balancing the regulatory cost burden. Ergon and Energex submitted that including specific requirements regarding model data obligations of generating systems below 30MW would be better addressed, if the NER prescribed the type of power system modelling data that will be required from different participants, and the circumstances in which it will require what type of power system model data [112]

3.2.4 Assessment

AEMO's ability to obtain model data

The Commission considers that there are two general avenues potentially open to AEMO in order to gather model data from participants:

- the general information gathering powers established under the NEL and
- the NER model data provision framework.

NEL information gathering powers

AEMO has an information gathering power under the NEL. This allows it to collect information it considers reasonably necessary for the exercise of a relevant function.

These relevant functions are:

(a) a national transmission planner (NTP) function, or

(b) an additional advisory function, or

(c) a declared network function, or

107 Meridian submission, 1 August 2017, p. 1

108 ENGIE submission, 2 August 2017, p. 2

109 AEMO submission, 8 August 2017, p. 5

110 Ibid., pp. 5-6

111 Ergon and Energex submission, 1 August 2017, p. 1

112 Ibid., p. 2

(d) any other statutory function for which this Law authorises AEMO to gather information by means of a market information instrument.[113]

For these relevant functions, AEMO may make a market information order or serve a market information notice to obtain this information. These require parties subject to the order or notice to provide information to AEMO.

The Commission considers that in relation to this rule change request, the NTP function is relevant, as it relates to the planning activities that require accurate power system modelling, as described in section 2.3.3. It is possible that AEMO could issue a market information notice or make a market information order in respect of its NTP function to obtain additional or more detailed model data from participants, where AEMO considers that the information is reasonably necessary for the exercise of its NTP function.

However, the Commission considers that use of these orders or notices would not represent an efficient approach for AEMO to obtain model data. Being required to issue a notice or order each time AEMO sought model data would impose costs on AEMO, in terms of the length of time necessary to prepare and issue the relevant order.

Such an approach to gathering model data is also relatively opaque and does not align with the general concepts of clarity and transparency that inform this final rule. That is, such an approach would not provide a clear and predictable framework that gave participants sufficient advanced notice regarding the type of model data that AEMO might request, or the conditions under which it might be requested. AEMO would also be limited to obtaining information that it considered reasonably necessary for the exercise of its NTP function which would necessarily limit the types of model data requested to what was needed for AEMO to exercise its NTP function.

As such the Commission does not consider that the NEL information gathering provisions provide a useful avenue for AEMO to seek more detailed or additional model data from participants.

NER model data provision framework

As discussed in Chapter 1, the NER already contains a model data provision framework. This framework sets out requirements for parties to provide model data to AEMO, and in some cases network service providers, in certain circumstances.

Whilst the existing framework in the NER may not prevent AEMO from obtaining additional model data, the Commission considers that given the importance of access to this more detailed model data for managing power system security, the circumstances in which AEMO can obtain model data, and obligations on participants to provide model data, need to clear and predictable.

The current NER model data provision framework requires model data to be submitted to AEMO by generators as part of their connection process,[114] when generators

113 See section 53(2) of the NEL.

114 See clause S5.2.4 of the NER.

propose an alteration to their generating systems,[115] and as part of the tender process for the provision of NSCAS and SRAS.[116]

However, the NER do not explicitly state the type of model data that is to be provided. The Commission therefore considers that there is some risk of uncertainty under the existing NER model data provision framework regarding what type of models and information is sufficient to meet the relevant obligations under the NER.

The Commission understands that common practice to date has been for participants to provide RMS-type model data in compliance with these provision obligations.

As this has become the standard interpretation of the NER obligations, the Commission considers it is possible that the circumstances in which participants are required to provide more detailed model data may be unclear. There is therefore a risk that what is required for compliance is unclear and participants could dispute any request from AEMO for more detailed model data.

This is particularly likely if there are material costs associated with complying with the request. In conversations with stakeholders, the Commission understands that there have already been several examples of participants disputing a request from AEMO for more detailed model data. The potential extent of these costs is discussed in section 3.3 below.

The Commission has therefore made changes to the NER model data provision framework to clarify that AEMO may request different kinds of model data from participants, and that the more specified requirements and circumstances will be set out in the guidelines and data sheets, which participants are required to comply with. This is discussed in further detail in section 3.4.

The Commission considers that the NER should continue to establish high level obligations and principles that guide participants and AEMO, while the guidelines and data sheets are the appropriate instrument for the provision of more detailed technical and operational information that is likely to require changes over time.

While the technical details of the model data that is required from participants under various circumstances must be set out in the guidelines, there is one universal requirement that applies to all types of model data. That is, it has to fulfil the purpose for which it was provided.

Therefore, the final rule requires participants, when providing information, to provide sufficient detail for AEMO and the relevant network service provider to perform power system simulation studies in accordance with the requirements and circumstances set out in the guidelines.[117] For the avoidance of doubt, the Commission notes that the obligations in the guidelines and data sheets that are created stemming from relevant clauses of the NER are mandatory for all relevant participants in the NEM. If an obligation on a participant was created in the guidelines or data sheets because a NER clause required such obligation to be set out in the guidelines or data sheets, it must be understood as an obligation under the NER.

115 See clause 5.3.9 of the NER.

116 See clause 3.11.5 and clause 3.11.9 of the NER.

117 See clauses 3.11.5(b)(5) , 3.11.9(g), 4.3.4(p), S5.2.4(b1), S5.3.1(a2) and S5.3a.1(a2) of the final rule.

The Commission also acknowledges that the existing NER model data provision framework applies only to generators, and specifically, generating equipment. This is reflected in the existing Generating System Model Guidelines, Generating System Design Data Sheet, and Generating System Setting Data Sheet, which apply only to generating systems. As the existing NER model data provision framework does not allow AEMO to source information from participants other than generators in relation to other kinds of plant equipment, this may impede AEMO's ability to request all model data necessary for it to conduct accurate power system studies.

The Commission has therefore expanded the existing NER model data provision framework to cover other types of participants, as well as plant and equipment owned by those participants. This is discussed in further detail in section 3.5.

3.3 Costs of providing more detailed model data

The Commission acknowledges that there may be costs associated with the provision of model data. The higher complexity of EMT-type models results in higher development costs for those models compared to RMS-type models.

The Commission understands that for a new connecting non-synchronous generator, the costs of developing an EMT-type model may be up to three times greater than an RMS-type model for the same setting.[118] Further, developing EMT-type models retrospectively for already existing equipment also substantially increases the costs for developing a model.

The Commission considers that providing improved clarity and certainty will allow participants to be better placed to manage and therefore minimise the extent of these costs.

3.3.1 AEMO's view

AEMO estimated the costs of compliance with developing EMT-type models based on its own experience. In its rule change request, AEMO described a case where during an acquisition of SRAS, it developed its own models. AEMO considered that assuming average engineering consultancy fees, the costs associated with the gathering of the required data and development of a model for a generating system was approximately $75,000.[119]

3.3.2 Stakeholders' submissions to the consultation paper

In their submissions to the consultation paper, stakeholders were generally concerned about the cost implications of developing EMT-type models. Alinta Energy estimated that "the likely costs for participants to provide a broader scope of modelling data, or more detailed EMT-type models to AEMO could be in the realm of $500k per generating unit."[120] EnergyAustralia noted, that while "estimated value of $75,000 for this modelling may be appropriate for new generating systems", for existing plant, "it

118 The same equipment may be modelled with different details and complexity. More detailed and more complex models cost more to be developed.

119 AEMO submission,12 April 2017, p. 8

120 Alinta Energy submission, 12 April 2017, p. 2

could be much higher depending on the specific scope of the modelling sought by AEMO".[121] According to Origin "the modelling, evaluation and testing that is required as part of the generator registration process, i.e. meeting generator performance standards, can cost a participant between $500,000 and $1,000,000 for a new generation unit or any significant modification to existing plant."[122] Siemens Gamesa estimated the costs of developing an EMT-type model "in the vicinity of €12,000,000".[123]

Ergon and Energex stated that their costs incurred while developing EMT-type models of their equipment "were a prudent investment" and were recoverable.[124] Energy Networks Australia added that for network service providers "costs could be material if additional modelling details are requested for existing plant that is complex in nature such as static var compensators (SVC) or static synchronous compensators (STATCOM)"[125] and the NER should allow for the recovery of such costs.[126]

Stakeholder submissions demonstrated differing views depending on whether model data was to be submitted as part of the connection process, while proposing alterations to equipment or from existing participants, where power system conditions changed significantly.

New connections

Ergon and Energex were of the view that AEMO's data provision requirements would not form a barrier to entry, moreover, they would be "seen as cost beneficial".[127] They added that in their experience, early modelling proved to be better for proponents, because it was easier for them to finalise their generator design and there were significant cost advantages.[128]

ENGIE, however, was concerned that "placing a rule obligation on generator participants to provide detailed modelling information could lead to a duplication of costs and subsequent barriers to entry".[129]

Proposed alterations

According to Basslink, "the undefined threat of remodelling when replacing a participant's equipment presents an unjust economic operational burden which would need to be offset by increased market offerings".[130] Hydro Tasmania noted that "some existing generator upgrades, particularly control systems, often have a large portion of their costs attributed to modelling".[131] It further added that "any further increase in costs could see these projects being unfeasible which would be a negative outcome for

121 EnergyAustralia submission, 12 April 2017, p. 2

122 Origin Energy submission, 2 April 2017, p. 3

123 Siemens Gamesa submission, 12 April 2017, p. 1

124 Ergon Energy and Energex submission, 12 April 2017, p. 12

125 Energy Networks Australia submission, 12 April 2017, p. 7

126 Ibid., p. 7

127 Ergon Energy and Energex submission, 12 April 2017, p. 13

128 Ibid., p. 12

129 ENGIE submission, 12 April 2017, p. 2

130 Basslink submission, 12 April 2017, p. 2

131 Hydro Tasmania submission, 13 April 2017, pp. 1-2

the power system as upgrades are often beneficial for power system security and performance."[132]

Existing plant

Some stakeholders were concerned about the cost implications of generators or other registered participants already connected to grid being requested to provide updated and more detailed model data, even if no alterations are proposed to their equipment.

EnergyAustralia stated that "such an exercise could result in much higher costs being imposed upon existing plant."[133]Alinta Energy added that apart from the significant cost, to existing participants AEMO's proposed solution would provide "little additional benefit for those participants".[134]

3.3.3 Stakeholders' submissions to the draft determination

In their submissions to the draft determination, stakeholders were generally supportive of the Commission's approach with regards to the cost of compliance.

Cost of compliance

PIAC noted that the long term benefits to consumers from more efficient operation, security and investment in the NEM will far outweigh the costs associated with providing information to AEMO. PIAC was also of the view that regulated businesses should be able to pass through the efficient costs of complying with the new guidelines in any case.[135]

ENGIE supported the requirement that AEMO must have regard to the reasonable costs of compliance by registered participants compared to the likely benefits from the use of the information.[136]

ENA was of the view that the cost recovery options via cost-pass through for NSPs outlined in the draft determinations are problematic, as most businesses are very unlikely to reach the cost pass through provisions, even if costs are aggregated over a financial year. ENA urged the Commission to more thoroughly address these issues in the Final Determination, including outlining how the proposed approach would work in practice.[137]

Basslink contended that the rule change represents an investment risk as the associated costs for registered participants are not limited by occurrence or value.[138]

Acceptable software simulation products

132 Ibid., p. 2

133 EnergyAustralia submission, 12 April 2017, p. 1

134 Alinta Energy submission, 12 April 2017, p. 3

135 PIAC submission, 1 August 2017, p. 1

136 ENGIE submission, 2 August 2017, p. 2

137 ENA submission, 1 August 2017, p. 5

138 Basslink submission, 28 July 2017, p. 1

Stakeholders held differing views on whether AEMO should be required to use reasonable endeavours to accept model data provided in a range of software simulation products and versions.

AEMO was of the view that such a requirement would lead to unintended consequences and adverse outcomes to the market. AEMO argued that it already accepts a wider range of power system simulation tools than it is customary in most international jurisdictions. It argued that it already accepts a wider range of power system simulation tools than it is customary in most international jurisdictions.[139] It suggested that such an increased diversity may not provide any tangible technical gain and will impose significantly higher costs to the market as a whole.[140]

AEMO submitted that models provided in incompatible software products will likely slow down the connection application process and as AEMO's timely assessment of the impact of new connections is paramount to ensuring adequacy of supply, and meeting federal and state renewable energy targets.[141]

ENA submitted that both NSPs and AEMO will incur higher costs when converting models to a common analysis platform in undertaking analyses involving multiple models and model accuracy was also likely to be compromised.[142]

Ergon and Energex suggested that registered participants should be required to submit models that align with the model used by the network service provider. They were of the view that otherwise registered participants may be faced with additional time delays, increased costs, and up-skilling and resource impacts in order to convert to the required jurisdictional software simulation modelling platform.[143]

Ergon and Energex contended that model format inconsistencies has resulted in several costly and inefficient outcomes for both Ergon Energy, Energex and the registered participant, particularly where the generator/network model provided a modelling format that was inconsistent with the wider network model developed in the industry standard PSSE software platform. They suggested that AEMO and jurisdictional NSPs consider determining what modelling platform should apply in the jurisdiction.[144]

DIgSILENT contended that the requirement on AEMO to "use reasonable endeavours to accept a range of software simulation products and versions" did not require AEMO to do anything and based on experience to date, the opportunity to the industry for AEMO to accept RMS and EMT models from alternative software platforms will be lost. It further added that the draft rule did not address this issue and would result in higher costs to the entire Australian power industry.[145]

DIgSILENT suggested that instead an obligation should be put on AEMO to maintain the NEM model in a range of software simulation products and versions and accept

139 AEMO submission, 8 August 2017, p. 3

140 Ibid., pp. 3-4

141 Ibid., p. 4

142 ENA submission, 1 August 2017, p. 2

143 Ergon and Energex submission, 1 August 2017, p. 7

144 Ibid., p. 7

145 DIgSILENT submission, 1 August 2017, p. 4

dynamic RMS and EMT models developed in a range of alternative software simulation products and versions.[146]

3.3.4 Assessment

The Commission acknowledges the extent of the potential costs that participants may face if they are required to provide more detailed model data, or to provide model data for equipment that had not previously been required.

AECOM provided evidence to the Commission regarding the potential extent of these costs, focusing on the development of EMT-type as opposed to RSM-type model data for different kinds of generators, at different stages of project development.

Box 3.4 AECOM advice: costs of EMT-type model development[147]

The advice the AEMC sought from AECOM looked at the cost implications of several scenarios where an EMT-type model would need to be developed.

For non-synchronous generators, three distinct cases could be identified:

- new connecting generators
- existing generators, where an EMT-type model is already available from the original equipment manufacturer in a generic format, it needs to be adjusted to the specific generator setting,
- existing generators, where an EMT-type model is not available and needs to be developed.

Synchronous generators only have two specific cases: new connections or existing generators where an EMT-type model is not available. This is because almost all of the existing synchronous generators in the NEM are over 10 years old and it is highly unlikely that the original equipment manufacturers of these equipment and control system hardware had developed any EMT type models at that time.[148]

Additionally, AECOM noted that it may be more economical to model synchronous generating systems in an RMS type software platform and the power electronics based asynchronous generating systems in an EMT type software platform and then use some form of hybrid simulation interface between the two software platforms.

The order of magnitude cost estimate for developing an EMT-type model is shown in the table below.

Table 3.1 Cost estimate of EMT-type models

non-synchronous generators	synchronous generators

146 Ibid., p. 4

147 AECOM, EMT and RMS model requirements, 23 May 2017. A copy of AECOM's report is available at www.aemc.gov.au

148 Ibid., p. 9

new connections	existing connections, model available	existing connections, model not available	new connections	existing connections, model not available
$200,000 to $400,000	$200,000 to $300,000	$400,000 to $700,000	$125,000 to $200,000	$220,000 to $375,000

The Commission notes that these costs may have material consequences for some participants, depending on the stage of development of a project, and the type of model data that is requested.

Stakeholders advised that these costs may have implications for the investment decisions made by generators. For example, Hydro Tasmania suggested that the imposition of these costs may dissuade a generator from proposing alterations to a generating system, which could have otherwise provided overall benefits to the market. Furthermore, the Commission acknowledges comments from stakeholders that uncertainty regarding the extent of potential model data obligations may introduce a degree of risk into the market that will increase costs generally.

While the Commission accepts these costs can be material,[149] overall they are likely to be outweighed by the range of potential benefits associated with the provision of additional or more detailed model data, especially when the circumstances in which such data is to be made available limited in a clear and transparent way.

As discussed in section 2.3, the Commission is satisfied that provision of additional model data is likely to provide beneficial outcomes by:

- supporting more effective power system studies by providing a better understanding of the state of the power system and therefore more efficient and secure operation of the power system.
- supporting the development of more accurate and effective constraint equations and generator performance standards, enhancing the ability of generators to deliver energy to market and providing reliability benefits to consumers.
- enabling more efficient and effective procurement of ancillary services, helping to reduce the cost of these services while supporting the secure supply of energy to consumers.
- supporting more efficient planning processes, enabling better integration of a greater range of generating technologies and helping to lower network costs as well as providing improved system security and reliability outcomes.

149 The Commission notes that there were significant differences in the extent of cost estimates from various stakeholders and from the analysis undertaken by AECOM (see box 3.3). Most stakeholders and the advice from AECOM indicated a range of costs from $70,000 to $700,000, with one estimate of €12,000,000 (approx. $AUD17,700,000). No detailed explanation was provided as to the basis of this largest estimate.

The Commission is therefore satisfied that the extent of these benefits is likely to outweigh the potential costs that may be faced by some participants who are required to provide additional or more detailed model data.

However, it is also important that the costs faced by participants are no higher than necessary. The Commission considers this will be supported where participants are able to effectively plan for and therefore manage the costs associated with model data provision.

The final rule does this by providing clarity in the NER regarding who will be required to provide model data and the circumstances in which it must be provided. It also requires AEMO to provide further detail in its guidelines and data sheets regarding the more specific conditions or triggers under which model data will be provided.[150]

It also imposes a principles based objective on AEMO to have regard to the reasonable costs of efficient compliance by registered participants when developing the guidelines and data sheets.[151] These aspects of the final determination are discussed in more detail in section 3.4.

The Commission considers that earlier and clearer knowledge of model data requirements will enable participants to make efficient decisions, as they will be better equipped to plan for and manage the costs of model provision.

For example, providing clarity upfront regarding what model data will need to be provided by a connecting generator will allow potential generator proponents to plan for and incorporate any costs associated with model provision into their initial negotiations with providers of generation equipment.

The Commission understands that the development of EMT-type models may constitute a higher cost for existing participants. However, increased clarity will also help these participants manage costs, in as much as it will allow them to account for costs when planning alterations to plant. Accurate model data is also required for determining whether a planned alteration is likely to be beneficial for the power system. The provision of improved clarity regarding model data obligations forms the basis of the Commission's development of the final rule. The Commission's reasoning is set out in further detail in section 3.4.

The final rule also recognises that there are costs associated with the provision of model data to AEMO and network service providers as part of the connection process. Time is an important factor, with new connecting participants requiring certainty about when and what type of data will be required by AEMO or the network service provider during the connection process. Connection projects may have particularly important project deadlines (for example in relation to project financing) and therefore it is important for developers to have a clear understanding of the obligations they need to meet and when they need to meet them.

The final rule therefore seeks to provide clarity regarding the timeframes associated with this process. The final rule requires AEMO to establish in its guidelines and data

150 See clause S5.5.7(b1) of the final rule.

151 See clause S5.5.7(c)(1) of the final rule.

sheets, the relevant timeframes within which parties and AEMO must provide information to each other.[152]

Acceptable software simulation products

The draft rule sought to help manage costs for participants by allowing for different software packages to be used for the provision of model data. The Commission understands that there are various products that allow the development of EMT-type models and providing them in just one particular format may further increase costs for registered participants. The draft rule therefore required AEMO to use reasonable endeavours to accept a range of software simulation products and versions.[153] This was aimed at helping participants to manage costs by electing to use the software package of their choice.

Following the publication of the draft determination, the Commission undertook further consultation with stakeholders on the issue. The Commission understands that while a combination of RMS and EMT-type models of certain equipment may be used to create a hybrid power system simulation, it is not possible to create a simulation by linking different software simulation products together. Therefore, in order to conduct power system simulation studies AEMO and network service providers must use a single software product. As model data of equipment forms an input into those simulations, it must either be submitted to AEMO and the network service provider in the nominated format, or it must be converted to the acceptable format.

The Commission understands that the conversion of model data from one format to another may compromise the accuracy of the model and may also cause delays. While the Commission acknowledges the possible savings achieved by some registered participants if a wider range of software products were to be accepted by AEMO and network service providers, it also recognises the increased costs such an exercise would impose on AEMO and network service providers. AEMO's costs would likely be passed on to market participants via participant fees, while network service providers would pass their costs on to consumers, or seek cost recovery directly from the participant.

In addition, AEMO is already required to have regard to the reasonable costs of efficient compliance by registered participants compared to the likely benefits from the use of the information provided under the guidelines and data sheets.[154] This principle based objective provides appropriate avenues for registered participants for managing their costs.

For these reasons, the Commission decided to remove the clause from the final rule that would have required AEMO to use reasonable endeavours to accept a range of software simulation products and versions.

Cost pass through for network service providers

The Commission notes that while network service providers may face some additional costs in developing and providing more detailed models, network service providers can seek to recover these costs as part of the regulatory revenue determination process with

152 See S5.5.7(b1)(4) of the final rule.

153 See S5.5.7(c)(2) of the draft rule.

154 See clause S5.5.7(c)(1) of the final rule.

the Australian Energy Regulator. Where such a cost is incurred during a regulatory control period, a network service provider may apply, where applicable, to have these costs passed through under the cost pass through provisions in chapters 6 and 6A of the NER.

The Commission understands that if the costs of providing model data to AEMO in current regulatory periods do not satisfy the cost pass through provisions, then such costs will need to be absorbed by the network service provider. The Commission considers that network service providers are able to include an allowance for the costs of model data provision in the operating expenditure of their revenue forecast for the next regulatory period based on the expected volume of such work.

3.4 Conditions for provision of model data

Clarity and predictability

The circumstances that necessitate the type of models required by generators, network service providers and network users should be clearly set out and understood by all participants in the NEM. This will help to reduce uncertainty for participants and assists in the management of costs. It will also provide AEMO and network service providers with certainty regarding their ability to access the model data necessary to undertake effective power system studies.

The Commission considers that there is a role for both the NER and AEMO's guidelines and data sheets in providing this clarity. The NER should provide high level guidance in terms of the responsibilities of certain parties to provide model data and the guidelines and data sheets should then set out the more specific and technical details regarding the kinds of model data that must be provided and the specific circumstances in which that data should be provided. These technical details include the level of accuracy expected from each type of model data.

The final rule therefore amends the NER model data provision framework to specify the range of participants who are required to provide model data. In effect, it expands the coverage of the existing framework to encompass new participants, including network service providers, certain network users, market network service providers, prospective or tendering ancillary service providers. It does this by requiring these participants to provide the information in accordance with the requirements of the NER, as well as the more specific requirements set out by AEMO in the guidelines and the data sheets, which participants are required to comply with.

Participants are required to comply with the NER, which set out the obligation for relevant participants to comply with the guidelines and data sheets, and therefore, participants are required to comply with the obligations and requirements set out in the guidelines and data sheets. The Commission considers that the specific details of all of the model data and the precise circumstances under which model data should be provided should not be specifically prescribed in the NER.

Instead, the revised Power System Model Guidelines and associated data sheets are the appropriate place for the specific, technical and detailed model data obligations to be set out. This will provide the market with transparency regarding exactly what model

data will be required, how accurate that model has to be and in what circumstances it will be provided.

The final rule therefore requires the revised Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet to describe the kinds of model data that will be required, including references to specific types of models, the model accuracy requirements that apply to each type of model and plant and the particular power system conditions that trigger the need for particular types of modelling information.[155]

Placing these more detailed matters in the guidelines and data sheets will provide for greater flexibility to amend the requirements and obligations as technologies and system conditions change over time. Furthermore, because the development and maintenance of the guidelines and data sheets is subject to the rules consultation procedure, market participants will have the opportunity to provide input into the ongoing development of appropriate technical requirements for power system modelling.[156]

The Commission's analysis on why this provides improved clarity is set out in the remainder of this section and in section 3.5.

Conditions for provision of model data

The Commission considers there are four broad cases where participants may be required to provide model data (including in some circumstances more detailed or additional model data):

1. at the time of negotiating a new connection to the electricity network, or when parties are tendering for the provision of NSCAS or SRAS
2. when alterations or additions are proposed to existing connected generating systems or other plant or equipment
3. when surrounding power system conditions have changed, such that older model data no longer remains adequate and AEMO considers that the plant in question may impose an adverse effect on the power system, such as where there has been a significant reduction in system strength.
4. when AEMO considers that network service providers need updated model data to accurately assess how new connecting market network service providers or generators will impact system strength.

Some of these cases are currently contemplated by the NER model information provision framework, while others are not.

3.4.1 AEMO's view

In its rule change request, AEMO nominated several, more specific conditions where it considered it may need access to more detailed or additional model data. These included:

155 See clause S5.5.7(b1) of the final rule.

156 See clause S5.5.7 of the NER.

- **When connecting new generators**: AEMO also considered that more detailed model data will assist in the assessment of new generators seeking to connect to the power system.[157]
- **When a generator proposes alteration of a generating system:** AEMO stated in its rule change request that changes, including those to generating systems covered by clause 5.3.9 of the NER, even if they are considered to be 'like-for-like', should also automatically trigger a request for updated models and other data referred to.[158]
- **When there is a risk of adversely affecting the power system:** Additionally, in AEMO's view, updated and more detailed models may be required from generators, transmission network service providers or other registered participants if in AEMO's reasonable opinion, there is a risk that the generating system will adversely affect other network users or power system security or quality or reliability of the power system.[159] AEMO was of the view that this could apply in a retrospective manner, based on circumstances in the power system.

3.4.2 Stakeholder's submissions to the consultation paper

Stakeholders had differing opinions on the issue of the cases where more detailed and/or additional model data should be provided to AEMO.

New connections

Stakeholders generally did not oppose the requirement of providing more detailed model data for new connections.

Energy Networks Australia noted that "new requirements that specifically provide for the provision of such information at the design stage will result in more comprehensive and accurate connection assessments and more efficient connection processes."[160]

ENGIE was concerned that if more detailed model data was a requirement to be provided to network service providers and AEMO separately, that would duplicate costs and form a barrier to entry.[161]

Proposed alterations

Some stakeholders were concerned about AEMO's proposed changes to the requirements on generators or other registered participants to provide more detailed and/or updated modelling data when alterations were proposed to equipment. Generally, stakeholders were concerned that AEMO proposed to alter the existing NER

157 AEMO, rule change request, 31 October 2016, p. 5.

158 Ibid., p. 5.

159 Ibid., p. 5.

160 EnergyAustralia submission, 12 April 2017, p. 7

161 ENGIE submission, 12 April 2017, p. 2

clauses, which require additional data to be provided in specific conditions, to require provision of model data where AEMO considered this necessary.[162]

ENGIE submitted that it is very concerned at the level of discretion being proposed for AEMO in relation to existing generators that choose to carry out plant modifications, because this could lead to the unintended consequence of "barriers to improvement", where participants avoid making upgrades and improvements for fear that they may not be able to economically meet more onerous data obligations.[163]

Alinta Energy considered that the if additional model data was to be provided to AEMO because of a proposed alteration, there should be further guidance on what changes would trigger that requirement to be activated.[164]

Existing plant

Most stakeholders were concerned about the cost implications of the possibility that generators or other registered participants already connected to grid may be requested to provide updated and more detailed model data, even if no alterations are proposed to their equipment.

Basslink stated that such a possibility would send the message of investment uncertainty which would undoubtedly increase risk premiums by way of market offerings.[165]

Hydro Tasmania was of the view that proposed rule change would impose additional costs on all participants; therefore any ambiguity on obligation for participants is not desirable.[166]

AGL did not support the notion of allowing AEMO to retrospectively request model data from existing generators. AGL considered that data would either be unavailable or the cost of compliance would be very high.[167]

Energy Networks Australia, Ergon and Energex supported the requirement that in some cases related to system strength or network stability, existing generators should

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162 NER clause 5.3.9 currently sets out the conditions under which a generator who has proposed to alter a generating system must provide to AEMO and the relevant NSP details of the generating unit design data and generating unit setting data in accordance with the Generating System Model Guidelines, Generating System Design Data Sheet, or Generating System Setting Data Sheet. Currently, the NER specifies the conditions under which this data must be provided as being where the alteration will affect the performance of the generating system relative to any of the technical requirements set out in clauses S5.2.5, S5.2.6, S5.2.7 and S5.2.8. AEMO's proposed rule changed these specific references to the schedules into a general discretionary provision that would allow AEMO to request this data when it considered there was a risk the alteration would adversely affect network capability, security, quality or reliability of supply.

163 ENGIE submission, 12 April 2017, p. 2

164 Alinta Energy submission, 12 April 2017, p. 4

165 Basslink submission, 12 April 2017, p. 3

166 Hydro Tasmania submission, 13 April 2017, p. 2

167 AGL submission, 25 May 2017, p. 1.

provide additional and updated model data to AEMO and to network service providers.[168]

3.4.3 Stakeholder's submissions to the draft determination

Stakeholders addressed various issues of the cases where more detailed and/or additional model data should be provided by participants.

ENA submitted that network service providers should have the right to ask for EMT-type models from existing and new generators.[169] It further added that draft rule provisions appear to adequately address the needs and requirements of AEMO; however, there appears to be a lack of equivalent clarity and certainty in the draft rules about the position of network service providers.[170]

AEMO was concerned that references in clauses 4.3.4, S5.2.4 and S5.3.1 of the draft rule in relation to providing model source code to AEMO "where available" might be misinterpreted so that source code for RMS-type models would not be submitted to AEMO.[171]

The connection process and negotiated access standards

AEMO and NSPs identified a number of issues related to the model data provision of new connecting participants.

AEMO suggested that the NER should be updated so as to create a clear process and guidance around information requirements from connection applicants. AEMO contended that model data should be provided by connection applicants at the time of submitting their negotiated access standards to network service providers and AEMO. It was of the view that a clear and upfront requirement for connection applicants would be desirable in order to avoid unnecessary delays in the connection process.[172]

Ergon and Energex suggested that model data should be submitted during the enquiry and application to connect stage. According to Ergon and Energex this would create certainty and clarity regarding the framework and therefore allow participants to plan and account for these costs.[173]

3.4.4 Assessment

The Commission considers that given the importance of accurate model data as discussed in section 3.1.3, AEMO and network service providers should be able to access more detailed model data in those circumstances where this is warranted. This includes being able to source model data for new connections, where equipment is being altered and where AEMO considers that additional data is needed from existing plant.

168 Ergon and Energex submission, 12 April 2017, p.14, Energy Networks Australia submission, 12 April 2017, p. 1

169 ENA submission, 1 August 2017, p. 2

170 ENA submission, 1 August 2017, p. 1

171 AEMO submission, 8 August 2017, p. 3

172 AEMO submission, 8 August 2017, pp. 4-5

173 Ergon and Energex submission, 1 August 2017, p. 2

However, it is important that there is clarity and predictability regarding the specific conditions where more detailed or additional model data should be provided.

The final rule therefore provides additional clarification regarding the circumstances in which model data can be requested. This includes a requirement that AEMO sets out in the guidelines and data sheets:

- the types of models that it will request from a range of different participants
- the conditions under which it will require specific models
- the types of models that AEMO may request from a participant that is proposing to alter its equipment.

Additionally, the final rule clarifies that generators, network service providers, certain network users and market network service providers will face an ongoing obligation to provide AEMO with updated model data, where requested to provide this by AEMO.[174]

The final rule also contains a requirement that the guidelines must include a process to account for situations where a participant is unable to comply with a request for model information.

Types of models to be requested from different participants

The Commission considers that the guidelines must specify the factors and conditions that AEMO must take into account when it requests model data from registered participants. This guidance should be provided for new generator, network service provider, market network service provider or network user connections, proposed alterations to existing plant, when surrounding power system conditions have changed and the procurement of ancillary services.

The final rule therefore establishes a requirement for AEMO to clearly specify in its guidelines and data sheets, the information, including the types of models, that it will request from generators, network service providers, market network service providers, certain network users, NSCAS tenderers and prospective SRAS providers.[175]

The Commission understands that in order to support accurate power system studies, model data must be an accurate reflection of the specific plant that it represents. The final rule therefore requires AEMO to specify in the guidelines the model accuracy requirements that are applicable to each type of model provided, as well as the types of generating systems and other plant that the model accuracy requirements apply to.[176]

Conditions under which AEMO will request model data

The Commission considers that AEMO's need for different kinds of model data will depend on specific circumstances. For example, as discussed in section 3.1.3, more detailed EMT-type model data is likely to be needed to deliver accurate power system studies in low power system strength environments. In contrast, it may be sufficient for

174 See clauses 5.2.3(j) and (k); 5.2.3A(a) and (b); 5.2.4(c) and (d); 5.2.5(d) and (e) of the final rule.

175 See clause S5.5.7(b1)(1) of the final rule.

176 See clause S5.5.7(b1)(2) of the final rule.

AEMO to use RMS-type models in a higher system strength power system environment.

The Commission considers that clarity can be provided to the market by requiring AEMO to specify the circumstances and more specific power system conditions under which these different kinds of model data may be requested.

The final rule therefore requires AEMO to specify in the guidelines and data sheets the circumstances in which different kinds of model data will be requested. Specifically, AEMO will be required to provide guidance on the factors that it will take into account when determining the circumstances under which it will request model data, including the particular power system conditions that necessitate the usage of a certain type of model in order to achieve the desired level of accuracy.[177] The final rule also requires AEMO to specify when model data source code will be required.[178]

Network service providers' access to model data

The Commission acknowledges that network service providers have certain obligations that may require the network service provider to have access to model data from future and existing registered participants.

For example, in order to meet the requirement to comply with quality of supply standards and power system performance standards[179] network service providers may need access to more detailed model data. Similarly, network service providers may need access to detailed model data when assessing proposed negotiated access standards.[180]

In order to determine the possible effects of a new connection, updated model data may be required from existing connected participants.

The model data provision framework introduced by the draft rule required existing generators to provide model data to AEMO in accordance with the circumstances specified in the guidelines.

While the final rule enables AEMO to request model data from existing registered participants when in its reasonable opinion there is a risk that the plant will adversely affect network capability, power system security, quality or reliability of supply, inter-regional power transfer capability, or the use of a network by a network user, or system strength,[181] the final rule also makes it clear that this information is required to be provided to the relevant network service provider(s) at the same time. This could include both the distribution network service provider and transmission network service provider.

The final rule does not amend the current model data provision framework in terms of which party needs to be provided with the model source code. Such information

177 See clause S5.5.7(b1)(5) of the final rule.

178 See clause S5.5.7(b1)(7) of the final rule.

179 See clause 5.2.3(b) and schedule 5.1 of the NER.

180 See clause 5.3.4A(f) of the NER.

181 See clauses 5.2.3(j), 5.2.3A(a), 5.2.4(c) and 5.2.5(d) of the final rule.

continues to be provided to AEMO only. The final rule does specify that this source code needs only to be provided in specific circumstances.

The final rule therefore includes separate clauses that specify that encrypted model data is provided to network service providers and AEMO, while source code model data is provided only to AEMO in the circumstances set out by AEMO in the guidelines.

The Commission did not introduce the ability for network service providers to request and obtain information directly from registered participants in these circumstances, as it considers that AEMO continues to be appropriate party that is able to initiate such requests. As market operator, AEMO is best placed to bear the responsibility for requesting model data that may impose costs on participants. This will help to address concerns of participants that network service providers may impose unreasonable or costly requests for provision of model data.

However, the Commission also considers that transmission and distribution network service providers have different information requirements to AEMO, which may include cases where AEMO would not require information.

Therefore, the final rule requires AEMO to have regard to the data and modelling information requirements of both distribution and transmission network service providers that are necessary for them to fulfil their obligations under the NER or jurisdictional electricity legislation.[182] This applies to the entirety of the model data provision framework.

The Commission considers that this will mean in practice that AEMO will engage with network service providers when developing the guidelines in order to understand the types of model data that may be required at different times by both transmission network service providers and distribution network service providers, noting that each type of network business may have different needs in terms of what type of model data is required. This will allow for the provision of data required by network service providers through the guideline process, while also providing clarity and certainty for participants.

Provision of model data by an existing registered participant

The Commission considers that existing registered participants may need to provide model data in circumstances other than where they are proposing an alteration of existing plant. This may occur where power system conditions have changed around a registered participant and AEMO requires updated model data from the registered participant to maintain the accuracy of its power system studies, or where additional model data is required by a network service provider for the purposes of system strength impact assessment in relation to new connecting generators or market network service providers.

The Commission considers that the existing NER model data provision framework may already impose some obligations on generators to provide updated model data in this case.[183] However, the final rule introduces a new clause that specifies an obligation on

182 See clause S5.5.7(c)(3) of the final rule.

183 NER clause S5.2.4(d) allows AEMO or the relevant network service provider to request updated model data from a generator where AEMO or the relevant network service provider considers that

generators to provide model data, where requested by AEMO. This is intended to clarify that existing generators may be required to provide updated model data, even if they have not proposed an alteration to their generating system.[184]

The Commission understands that certain equipment owned by network service providers and network users other than generators (such as larger customers) as well as market network service providers may also affect the accuracy of power system studies, particularly in low system strength conditions.

The final rule therefore expands the framework so that AEMO can also obtain information from existing network service providers,[185] market network service providers,[186] and certain network users (customers)[187] in certain circumstances. AEMO may request information where it reasonably considers that there is a risk that the relevant participant's plant will:

- adversely affect network capability, power system security, quality or reliability of supply, inter-regional power transfer capability;
- adversely affect the use of a network by a network user; or
- have an adverse system strength impact.

Furthermore, if in AEMO's reasonable opinion additional information is required for network service providers to undertake a system strength impact assessment as required by the *Managing power system fault levels* rule, AEMO may request such additional information from an existing registered participant. AEMO's ability to request additional model data for system strength purposes is discussed in the next section.

AEMO is required to set out in the guidelines the more specific circumstances, such as the power system conditions, in which it will request this information, as well as the type of information it will request in these particular circumstances.

However, the Commission recognises that requesting model data from an existing registered participant who is not proposing an alteration to its plant or equipment could impose material costs on that registered participant. The final rule therefore requires AEMO, when developing the guidelines and data sheets, to have regard to the reasonable costs of efficient compliance by registered participants, as compared to the likely benefits from the use of the information provided under the guidelines and data sheets. The guidelines and data sheets directly apply to such requests by AEMO to a

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the information in incomplete, inaccurate or out of date. However, the Commission notes that this clause is contextually in the NER as part of the process of connection of a new generator, and therefore may possibly be limited in application to situations where information provided becomes inaccurate during the connection process. The final rule is designed to apply more generally, including to existing connected generators that have completed the connection process.

184 See clause 5.2.5(d) of the final rule.

185 See clause 5.2.3(j) of the final rule.

186 See clause 5.2.3A(a) of the final rule.

187 See clause 5.2.4(c) of the final rule.

generator, a network service provider, a market network service provider or a network user (customer) for additional model data.[188]

The Commission also considers that the obligation in the final rule for AEMO to set out in the guidelines the factors it will take into account when determining the power system conditions that trigger the use of a certain type of model will provide predictability and clarity to participants as to when AEMO may request model data from existing participants.[189]

Power system fault levels (system strength)

Under the *Managing power system fault levels* rule[190] network service providers are required to assess, in accordance with a guideline determined by AEMO, whether the connection of a new generator would adversely impact power system security in terms of system strength.

Network service providers must be able to accurately assess the power system in order to determine whether the connection of a new generator or market network service provider would have an adverse impact. Such assessment necessitates accurate and updated model data for all relevant grid connected equipment in a particular area, including existing equipment.

the final rule enables AEMO to be able to request model data from existing participants if the risk of an adverse system strength impact is not directly related to their plant, but to the new connecting market network service provider or generator. If in AEMO's reasonable opinion additional information is required for network service providers to assess the impact of that new connection on system strength, AEMO may request such additional information from registered participants.[191]

The Commission acknowledges that there may be cost implications for existing participants if they are required to provide updated model data about their plant in such cases. However, there may also be some benefits to the existing plant as a result. These include having a more thorough understanding of the stability implications of new connecting plant for existing plant, necessary to enable an appropriate system strength remediation scheme to be developed to address the impact of new generator's connection, including on the existing generator ..

The Commission also considers that the provision of this model data, while potentially imposing costs on some existing participants, may support a more stable power system generally, helping to reduce the need for the imposition of constrains by AEMO to maintain system stability. The Commission considers that the extent of this general benefit is likely to outweigh the specific costs imposed on any individual participant.

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188 For network service provider, a market network service provider or a network user (customer) obligations see clauses 5.2.3(j), 5.2.3A(a), 5.2.4(c) 5.2.5(d) the final rule. For generator obligations see clause 5.3.9(a) of the *Managing power system fault levels* final rule.

189 See clause S5.5.7(b1)(5) of the final rule.

190 See AEMC, *Managing power system fault levels*, Final Determination, 19 September 2017

191 See clauses 5.2.3(k) 5.2.3A(b) 5.2.4(d) and 5.2.5 (e) of the final rule.

The Commission expects that, consistent with the relevant guidelines principle that requires AEMO to have regard to the network service providers' obligations under the NER or jurisdictional electricity legislation, the implementation of these clauses relating to system strength,[192] will be reflected in the guidelines. This is because when AEMO is applying its adverse effect test related to system strength, such decision is likely to require processes, considerations and technical details that will be set out in the guidelines.

The connection process and negotiated access standards

As stated in section 2.3.3, the Commission considers that the connection process is better informed through more accurate power system studies, so that AEMO, network service providers and connection applicants may be better able to identify the optimal location of their plant in the network so as to identify and manage connection related problems. The negotiation of access standards is a key element of the connection process. If a negotiated access standard is sought, the relevant network service provider must consult with AEMO on those proposed negotiated access standards that are AEMO advisory matters before approving or rejecting the standard.[193]

AEMO is currently required to respond to the relevant network service provider within 20 business days following the submission of a proposed negotiated access standard.[194] The network service provider is required to respond within 30 business days from receiving the proposed negotiated access standard.[195]

The Commission understands that AEMO's advice on the proposed standard relies on model data that should be provided together with the submission of the proposed standard. The Commission acknowledges that whilst in practice such model data is submitted to AEMO and network service providers, this has not always been in a timely manner. Therefore, the final rule clarifies that AEMO and the network service provider are only required to respond to the proposed negotiated access standard within the deadlines set in the NER, once the connection applicant has provided all the information necessary for AEMO and the network service provider to assess the proposed standard.

Alteration of a generating unit or network element or network user equipment

Alteration to a generator's, network service provider's, market network service provider's or network user's equipment located in a low system strength location can have adverse effects on other parts of the power system. However, not all circumstances of weak network location will necessarily require the use of more detailed model data, regardless of how material the proposed change to the equipment is.

The final rule therefore requires the guidelines to set out the types of models that AEMO may request from generators, network service providers, market network

192 This expectation only applies to cases where AEMO applies the adverse effect test directly to the plant that is owned by an existing registered participant and not to cases where network service providers need more information from existing registered participants to assess the impacts of a new connecting MNSP or generator on system strength.

193 See clause 5.3.4A of the NER.

194 See clause 5.3.4A(d) of the NER.

195 See clause 5.3.4A(e) of the NER.

service providers and network users who are proposing to alter their generation systems or plant or equipment, or connect new or additional equipment to the network, where AEMO considers that the alteration or connection of such equipment may have broader network impacts.[196]

The guidelines must also set out the factors that AEMO will take into account when determining the circumstances under which it will request information, including the power system conditions that necessitate what type of models to be provided by generators, network service providers, market network service providers and network users proposing the alteration or connection, as well as the model accuracy requirements that are applicable to each type of model provided.[197]

Difficulty in providing model data

The Commission understands that there may be some limited circumstances in which a participant is unable to obtain model information about existing plant. For example, this may occur where the original equipment manufacturer of the plant has ceased operation and the original models are no longer available. The costs of developing detailed models of a plant that has passed a certain age may be so excessive, that they may outweigh the benefits of being able to accurately model the plant. Participants may be able to find alternative solutions, such as using high speed and trend recorders,[198] that would help achieve the same goal that a more detailed model could, but at a lower cost.

The final rule, therefore, includes a requirement for AEMO to set out in the guidelines a process to be followed in circumstances where a person is unable to provide information that is required under a relevant obligation.[199] The Commission expects that this process would largely reflect the existing "variation request" framework contained in the existing Generating System Model Guidelines.[200]

The framework allows participants to request a waiver from meeting some requirements set in the guidelines and data sheets, by stating reasons and providing evidence for not being able to meet those requirements. The relevant network service provider and AEMO must then:

- accept or reject the request
- propose alternatives or options for the generator or connection applicant to consider, or
- request further information.

The Commission recognises AEMO's submission that the wording related to the provision of source code in the draft rule could have been misinterpreted so that source code for RMS-type models would not be provided to AEMO.

196 See clauses 4.3.4(n), 5.3.9(b)(2), S5.3a.1(a1), S5.3.1(a1) and S5.5.7(b1)(1) of the final rule.

197 See clauses S5.5.7(b1)(2) and (5) of the final rule.

198 Origin Energy submission, 2 April 2017, p. 3

199 See clause S5.5.7(b1)(4) of the final rule.

200 See section 5.1 of the Generating System Model Guidelines.

The Commission is satisfied that the existing "variation request" framework remains appropriate in addressing cases where model data is not available for registered participants. The Commission also understands that typically source code for EMT-type model data will not be required by AEMO.

However, if source code was required in the NER by default, registered participants could have had to use the variation framework and apply for an exemption in relation to model source code in each case where they were required to provide EMT-type models. The Commission considers that the use of the variation framework in such cases would not represent an efficient approach for registered participants.

Consistent with the Commission's approach that the type of model data that is required in certain circumstances should be set out by AEMO in the guidelines, the circumstances in which source code for models is required should also be set out in the guidelines.

Therefore, the final rule removed the words "where available" from the draft rule in relation to the provision of model source code and requires registered participants to provide model source code in the circumstances required by the guidelines.[201] The final rule also requires AEMO to set out in the guidelines the circumstances in which model source code is required to be provided.[202]

Protection systems

The draft rule included a requirement for network users that intended to connect any new or additional equipment to a network that is intended to consume or use in excess of 20,000 MWh per annum to submit specific type of information to AEMO about the control systems of the equipment.[203]

The draft rule did not specify that these participants were also required to provide model data related to protection systems.[204] Consistent with the Commission's approach of providing greater clarity on the obligations for registered participants about the type of information they need to submit under the model data provision framework, the Commission decided to include a specific reference to the provision of model data for protection systems of the equipment in this framework.

Therefore, the final rule includes explicit requirements for certain network users, including customers, network service providers and market network service providers to provide information about the protection systems of the equipment before they connect any new or additional equipment to the network. The final rule also clarifies that this obligation also applies to new connecting generators.[205]

201 See clauses 4.3.4(o)(2), S5.2.4(b)(6), S5.3.1(a1)(5) and S5.3a.1(a1)(5).

202 See clause S5.5.7(b1)(7) of the final rule.

203 See S5.3.1(a1) of the draft rule.

204 See S5.3.1(a1)(6) and S5.5.7(a)(2) and (3) of the draft rule.

205 See clauses 4.3.4(o)(1)(i) and (ii); S5.2.4(b)(5)(i) and (ii); S5.3.1(a1)(1) and (2); S5.3a.1(a1) and (2); of the final rule.

3.5 Range of participants required to provide information

As described in section 3.1, there are system conditions that negatively affect the accuracy of modelling generating units. These conditions also affect how other, previously not modelled, equipment interacts with the power system. Such equipment may be owned by generators, transmission network service providers, distribution network service providers, market network service providers or customers of the transmission or distribution networks.

Therefore, the range of participants from whom model data is required, as well as the types of equipment about which model data is required, is increasing. Additionally, where generators of a smaller size (i.e. 30 MW or less) propose to connect to a "weak" part of the network, the consequences of such connection to the network for the rest of the power system may be just as severe as if generators greater than 30MW connected to a relatively stronger part of the network. The subsections below describe AEMO's and stakeholders' views about whether and how model data for these kinds of equipment should be provided by network service providers and network users to AEMO.

3.5.1 AEMO's view

AEMO in its rule change request argued that other, previously not modelled equipment in the network (including reactive support plant, high-voltage direct current transmission links, large variable speed motor drives and protective functions) may be increasingly relevant to modelling the operation of the power system.[206]

In certain parts of the network, where local system strength is already at low levels and non-synchronous generators are in close electrical proximity to each other, more detailed modelling information may be required to allow effective assessment of the interactions between those generators and other network equipment. Having access to model data for additional types of network equipment as well as more detailed data about generating systems may therefore allow for more accurate and effective power system modelling by AEMO.

AEMO therefore proposed to amend the NER to expand the range of participants who will now be required to provide model data and expand the range of equipment for which such model data must be provided.

3.5.2 Stakeholder's submission to the consultation paper

In their submission to the consultation paper, stakeholders had differing opinions on the issue of requiring network service providers and large customers to provide model data about their equipment to AEMO.

Energy Networks Australia in its submission did not question AEMO's need to obtain such data from network service providers; however, it noted the possible costs and ability to recover these costs were a concern.[207]

206 AEMO, rule change request, 31 October 2016, p. 4

207 Energy Networks Australia submission, 12 April 2017, pp. 7-8

Ergon and Energex stated that despite the costs, modelling of such equipment can be considered to be a prudent investment, and were also of the view that model data should also be required from generators between 5 and 30MW or where the installed capacity of the plant was greater than 5% of the available system fault level. Both identified that the increasing penetration of smaller generation in their Queensland distribution networks was reducing system strength and necessitating the provision of more detailed model data from these participants.[208]

Basslink was concerned that if model data was to be provided by non-generating participants:[209]

- in a retrospective manner (i.e. by existing participants)
- when it was needed "in AEMO's reasonable opinion" (without further clarifying what that would entail) and
- even when the alteration of equipment would be "like-for-like"

the costs for providing such data would outweigh the benefits.

Hydro Tasmania was also of the view that requiring model data from non-generating participants would be an onerous obligation, because the overall aim of AEMO's proposed changes was principally to capture new asynchronous generation data.[210]

3.5.3 Stakeholder's submission to the draft determination

In their submission to the draft determination, stakeholders had differing opinions on the issue of requiring a greater range of participants to provide model data about their equipment to AEMO.

Basslink in its submission requested that due to its uniqueness to the NEM and the fundamental net good it does uncompensated for the NEM, it should be expressly excluded from this rule change.[211] It further added, that it should be considered a special case because of the relative size the interconnector relative to the adjacent AC network and it unique technology and its place in the market.[212]

Ergon and Energex submitted that including specific requirements regarding model data obligations of generating systems below 30MW would be better addressed, if the NER prescribed that EMT-type models required by generators above 5MW or 5% of the system fault level, whichever is lower.[213]

Ergon and Energex were concerned that the introduction of a 20,000 MWh per annum threshold related to the consumption or use of electricity by particular equipment, above which network users are required to provide modelling data to AEMO, will by default apply as a threshold for generating systems. They were also of the view that this threshold will not consider the particulars of the connected site or generating cluster

208 Ergon Energy and Energex submission, 12 April 2017, p. 12

209 Basslink submission, 12 April 2017, p. 2.

210 Hydro Tasmania submission, 13 April 2017, p. 2

211 Basslink submission, 28 July 2017, p. 1

212 Ibid., p. 1

213 Ergon and Energex submission, 1 August 2017, p. 2

and therefore will not accommodate weaker distribution networks such as Ergon Energy's.[214]

ENA was concerned, that the current 20,000 MWh per annum usage or consumption threshold for network users to submit model data could result in certain generators with lower capacity factors being exempt from this obligation. It suggested that it may be administratively simpler and clearer, if a 5MW threshold be consistently applied to generators.[215]

3.5.4 Assessment

There are a number of parties other than generators who may own and operate equipment that can impact on the effective operation and security of the power system. This equipment may be operated by a range of non-generator participants, including network service providers, market network service providers and network users (or customers). The final rule therefore brings these other participants into the NER model data provision framework.

Generators with a capacity less than 30MW (referred to as "smaller generators") are currently subject to a less defined model data obligation than larger generators. However, the Commission understands that these smaller generators are having an increasing impact on network security, particularly at the distribution network level. The final rule explicitly incudes these participants in the NER model data provision framework by linking their provision of model data to the guidelines and related documents.

Finally, the Commission considers that providers of ancillary services should be required to provide model data to AEMO in accordance with the model data provision framework.

This section sets out the Commission's approach to smaller generators, network service providers, market network service providers, network users and prospective or tendering ancillary service providers of SRAS and NSCAS.

Smaller generators

The Commission understands that there are certain distribution networks in the NEM in which system strength and short circuit ratios are very low. As described in section 3.1.3, low short circuit ratios decrease the accuracy of power system modelling. Because the short circuit ratio is a relative metric it depends on both condition of the network (i.e. system strength) and on the size of the generator it is applied to. Consequently, if system strength is low enough, smaller generating units may have the same negative effect on model accuracy as larger units would have on a relatively stronger system.

The NER model data provision framework currently inconsistently differentiates between generating units that are larger, equal to or smaller than 30MW. That is, NER clause S5.5.6 states that generating units equal to or smaller than 30MW will usually be

214 Ibid., p. 8

215 Ergon and Energex submission, 1 August 2017, p. 2

required to submit less registered system planning data and less registered data than is indicated in the guidelines and data sheets.[216]

Clause S5.2.4 states that a generator with a combined nameplate rating of 30MW or more must provide model data in accordance with the model data framework.

This means that generating units that are *equal to* 30MW would fall under both clauses. The final rule maintains the position of the draft rule in addressing this inconsistency by changing the wording of clause S5.5.6 so that it applies only to those generators smaller than 30MW (and not equal to). This is consistent with the rest of the NER which refers to two classes of generators by size, being those that are less than 30MW, and those that are equal to or greater than 30MW.

The Commission is, therefore, of the view that the current framework which describes information provision of model data in relation to generating units smaller than 30MW should be adapted so that network service providers' and AEMO's access to all necessary model data is clarified. As transmission network service providers and distribution network service providers are responsible for quality of supply to network users and play a major role in the negotiation of generator performance standards,[217] their access to accurate model data is important.

Therefore, the final rule clarifies the classification of smaller generators in respect of the NER model data provision framework, and consistent with the approach in the final rule for other types of participants, the guidelines and data sheets will specify what type of models should be provided and under what circumstances.[218]

Customers, market network service providers and network service providers

The Commission understands that certain equipment owned by network service providers, market network service providers and certain network users (such as large industrial customers) may affect the accuracy of power system studies modelling in low system strength conditions.

Equipment such as dynamic reactive support plant, transformers, high-voltage direct current transmission links, large variable speed motor drive and protective functions have a significant impact on the performance of the transmission network, both at a local level and across regions.

Model data about such equipment is necessary because it provides information about whether that equipment will remain connected to the network during fault conditions. Unexpected disconnection may have a negative effect on system security. Further, possible damage to the equipment may also occur as a result of inadequate power system modelling.

The NER model data provision framework currently does not expressly require model data about these kinds of equipment to be provided by participants including network service providers, market network service providers and certain network users (customers).

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216 See clause S5.5.6 of the NER.

217 See rule 4.14(o) of the NER.

218 See clauses S5.5.6 and S5.5.7(b1)(1)(i) of the final rule.

The Commission understands that there are costs associated with providing model data. Therefore, AEMO is required to take into account the principle of reasonable costs of efficient compliance in S5.5.7(c)(1) when developing the guidelines and data sheets, which specifically applies when AEMO is determining the more specific details of the guidelines, including setting out what type of models should be provided and under what circumstances, as well as the model accuracy requirements that are applicable to each type of model.[219]

Consequently, such information should only be required by AEMO if certain conditions in the power system are present or have changed in such a way, that the costs of providing the information do not outweigh the benefits in having the information (i.e. preventing the risks and costs associated with operating the power system with less certainty).

The draft rule introduced a 20,000 MWh per annum threshold related to the consumption or use of electricity by particular equipment, above which network users were required to provide model data to AEMO.[220] This threshold was consistent with AEMO's generator registration guidelines that allow generating systems with annual exports less than 20,000 MWh to apply for an exemption from registration as a generator.[221]

Following the publication of the draft determination, the Commission further consulted with stakeholders on the issue. The Commission understands that in some cases local small generation (depending on the capacity factor) or local load consumption may offset the annual export value of the registered participant in such a way that equipment that only operates intermittently may not be covered by the 20,000 MWh threshold. However, such intermittently operating equipment may affect the power system significantly at peak times. There may also be other factors (such as local system fault levels or the capacity of the plant) that provide a useful metric as to whether network users should be required to provide model data.

Consistent with the Commission's policy position that the NER should provide the appropriate flexibility to determine the circumstances under which participants are required to provide model data, the Commission considers that the particular threshold trigger for the provision of this information is best addressed in the guidelines and data sheets.

Therefore, the final rule does not set a 20,000 MWh per annum threshold related to the consumption or use of electricity by particular equipment, above which network users are required to provide model data to AEMO and the relevant network service provider. Instead, it requires, as a starting point, that all network users (to which clause S5.3.1 applies) provide the information required by clause S5.3.1(a1).

The Commission understands that the detail and the nature of information AEMO and network service providers require from network users may vary. Therefore, the final rule enables AEMO to exempt a network user from the requirement to provide some or

219 See clause S5.5.7(b1)(1), (2) and (6) of the final rule.

220 See clause S5.3.1(a1) of the draft rule.

221 See section 2.1 of AEMO's Guide to the NEM Generator Classification and Exemption, August, 2014

all of the information specified in that clause. AEMO is required to set out the circumstances in which it will grant these exemptions in the model guidelines.[222]

Market network service providers

The Commission understands that the possible ways of recovering the costs of complying with model data obligations may be different for each class of registered participant, including market network service providers. The Commission is, however, satisfied that the final rule provides an appropriate framework that requires AEMO to have regard to the reasonable costs of efficient compliance by all classes of registered participants.[223]

The relative size and importance of a registered participant in the NEM is proportional to the need for accurate models that represent the behaviour of equipment that belongs to that registered participant. This also applies to market network service providers.

Finally, the Commission is of the view that the effective functioning of the model data provision framework is dependent on capturing all registered participants whose operation affects the power system significantly. Consequently, it would not be appropriate to exempt a registered participant from the framework that affects the power system in a unique and significant way.

Therefore, the Commission decided that Basslink, as a market network service provider will be included in the model data provision framework.

The final rule introduces a clear requirement in the applicable schedule for market network service providers to provide relevant information when connecting any new or additional equipment to a network,[224] as well as when there is a risk the provider's plant will:

- adversely affect network capability, power system security, quality or reliability of supply, inter-regional power transfer capability;
- adversely affect the use of a network by a network user; or
- have an adverse system strength impact.[225]

Ancillary service providers

As described in section 3.1.3, the effectiveness of ancillary services can be assessed more accurately where more detailed model data is available.

Under the current NER, providers of NSCAS and SRAS are required to provide data, models and parameters of relevant plant, sufficient to facilitate a thorough assessment of the network impacts and power station impacts of the use of the relevant network support and control ancillary service.

However, the NER do not require this model data to be provided in accordance with the model data provision framework (i.e. the model guidelines). The Commission considers that bringing these participants into the NER model data provision framework will

222 See clause S5.3.1(a3) of the final rule.

223 See clause S5.5.7(c)(1) of the final rule.

224 See clause S5.3a.1(a1) of the final rule.

225 See clause 5.2.3A(a) of the final rule.

allow for the provision of better and more accurate models to AEMO, supporting more efficient procurement of more effective ancillary services.

The Commission notes that the final rule refers only to the provision of model data from ancillary service providers as part of the tender process to provide ancillary services. As such, it does not refer to any ongoing provision of additional model data once a contract (ancillary services agreement) has been entered into between AEMO and the ancillary service provider.[226] The Commission considers that AEMO may include any additional matters it considers necessary in the ancillary services agreement that it enters into with the ancillary service provider.[227] This could include clauses for the provision of additional or updated model data, where required by AEMO.

The final rule therefore requires NSCAS and SRAS providers to provide model data to AEMO as part of the tendering process, which must be provided in accordance with the requirements and circumstances specified in the guidelines and data sheets.[228]

3.6 The availability of information to other registered participants

The NER standing data framework currently sets out a process whereby AEMO is required to provide registered participants with model data that was previously provided by another participant, in an encrypted format, along with a releasable user guide where that information is reasonably required by the registered participant to carry out power system studies.[229] This model data is used by connecting generators as inputs into power system studies that are used to inform the negotiation of generator performance standards.

Under the new arrangements set out in the final rule, this model data that is passed on to third parties could include more detailed model data provided by participants under the final rule, such as EMT-type models.

The Commission considers that if the model data that the guidelines and data sheets require generators to provide is very detailed (such as an EMT-type model), it may include information that is regarded as sensitive intellectual property by original equipment manufacturers of generating systems, particularly non-synchronous, power system electronic connected generators.

Due to the extent of competition in the market for those technologies, original equipment manufacturers may have an interest in limiting the disclosure of intellectual property or other commercially sensitive information that could compromise their competitive advantage.

However, the Commission also considers that there are likely to be some benefits associated with allowing third parties to access more detailed model data, in certain situations. For example, a generator connecting in a part of the power system with low system strength may need to use encrypted EMT-type models in its own power system studies in order to negotiate generator performance standards.

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226 See clause 3.11.5(b)(6) and clause 3.11.9(a) and (d) of the NER.

227 See clause 3.11.5(b)(6) and clause 3.11.9(a) and (d) of the NER.

228 See clauses 3.11.5(b)(5), 3.11.9(g) and S5.5.7(b1)(1)(v) and (vi) of the final rule.

229 See clause 3.13.3 of the NER.

3.6.1 AEMO's view

AEMO did not address the issue of sharing model data with third parties in its rule change request.

AEMO in its submission to the rule change request was of the view that the requirement on participants to provide EMT-type model data, and the potential for this to be shared, would not threaten the intellectual property rights of original equipment manufacturers (OEMs).[230]

This is because in AEMO's view, the encrypted models of the control and protection systems without the associated transfer function block diagrams provide sufficient protection of commercially sensitive information.

3.6.2 Stakeholders' submissions to the consultation paper

Stakeholders had differing opinions on the issue of providing more detailed model data to participants other than AEMO.

Alinta submitted that because EMT-type models contain commercially sensitive information, including sensitive intellectual property of the OEM, such models should only be provided to AEMO and network service providers and should not be shared with other parties, such as generators.[231]

Siemens Gamesa noted that EMT-type models reveal sensitive information even when encrypted, and therefore only AEMO should have access. Siemens Gamesa, as an OEM, advised that it would decide on a case by case basis whether it would agree to provide its model data to another party.[232]

Vestas, also an OEM, noted that it would provide encrypted EMT-type models to any parties that require it on a need to know basis, provided that party signs a non-disclosure agreement with Vestas.[233]

Origin Energy was of the view that OEMs are not likely to provide detailed model data and/or will not agree to further sharing of such information.[234]

DIgSILENT,[235] Ergon and Energex[236] agreed that more detailed information should be shared with network service providers and also with other third parties.

Energy Networks Australia added that sharing model data with relevant participants would be desirable, because otherwise NSPs may be unintentionally assigned the role of default designer for the controller and protection settings of connecting plant.[237]

230 AEMO submission, 12 April 2017, p. 6

231 Alinta submission, 12 April 2017, p. 3

232 Siemens Gamesa submission, 12 April 2017, p. 2

233 Vestas submission, 12 April 2017, p. 3

234 Origin Energy submission, 12 April 2017, p. 5

235 DIgSILENT submission, 12 April 2017, p. 2

236 Ergon and Energex submission, 12 April 2017, p.5

237 ENA submission, 12 April 2017, pp. 8-9

3.6.3 Stakeholders' submissions to the draft determination

In their submissions to the draft determination, stakeholders had differing opinions on the issue of providing more detailed model data to registered participants.

In its submission Vestas reiterated the view it expressed in its previous submission to the consultation paper. Vestas noted that it will provide to AEMO EMT-type models in encrypted format, without source code or block diagrams. It has also submitted that providing such models is subject to a non-disclosure agreement signed between AEMO and Vestas, and if AEMO wishes to share the information with other parties, Vestas needs to informed and that third party must sign a separate non-disclosure agreement with Vestas.[238]

ENA suggested that the (model data) framework should introduce a more rigorous approach to confidentiality agreements and commercial in confidence arrangements, as to the application of a revised S5.2.4 to data provided by proponents or generation owners. It also pressed the importance of not unduly introducing liability for data provided by NSPs to AEMO.[239]

According to AEMO the modified standing data framework in clause 3.13.3(k1) will assist registered participants to access model and data beyond what is currently permitted in the NER. It further added that such information is critical for the correct and sustainable design of the plant (in particular, power electronic interfaced plant) in the vicinity of other plant owned by other registered participants.[240]

AEMO noted that it has in the past agreed to accept model data from the equipment manufacturers on behalf of those parties with the obligation to provide it. It added that these models are classified as confidential information. Registered participants are entitled to seek this type of information from AEMO, and the information remains confidential.[241]

AEMO stated that it will not be entering into any non-disclosure agreement in respect of information it is entitled to obtain, regardless of whether it is being provided by generators or persons negotiating a connection agreement, or the equipment manufacturer direct.[242]

Meridian agreed that the draft rule was sufficient in ensuring the confidential information of third parties and OEMs remains adequately protected.[243]

Early access to model data

Ergon and Energex submitted a range of issues stemming from the non-inclusion of all connection applicants in the standing data framework.

238 Vestas submission, 1 August 2017, p. 1

239 ENA submission, 1 August 2017, pp. 4-5

240 AEMO submission, 8 August 2017, p. 4

241 Ibid., p. 6

242 Ibid., p. 6

243 Meridian submission, 1 August 2017, p. 1

Ergon and Energex were concerned that connection applicants may not have access to relevant model data of generators or of other participants in their close proximity. They were of the view that the current data provision framework does not address the situation when generators are applying for connection within months of each other and there is no sufficient R1 or R2 model data available at the time.[244]

They were of the view that if connection applicants are not considered by AEMO to be intending participants at an early stage of the connection process, that could prevent them from having access to the relevant model data of other proponents that are connected, or are in the process of establishing a connection to the network. Ergon and Energex were of the view that this could slow and/or impact the connection applicant's progress through the connection process.[245]

Ergon and Energex contended that it is assumed that a connection applicant is able to submit its proposed negotiated access standards with its connection application for consideration by the NSP and AEMO. However these proposed standards may not be accurate if not supported by modelling that takes into account model data of other registered participants in the area.[246]

Ergon and Energex were concerned that if information sharing with third-parties was bound by non-disclosure agreements, inconsistencies may develop as each agreement may have different terms and conditions which don't allow uniformity in how this information may be shared.[247]

Ergon and Energex proposed to include an exception in the confidentiality-related provisions of the NER. They also suggested that an exception should be placed in clause 5.3.8 that sets out the circumstances where data and information provided under clauses 5.3 and 5.3A may be disclosed and that the provider must ensure the information is capable of being disclosed upon providing.[248]

3.6.4 Assessment

Access to more detailed, EMT-type model data allows connecting generators to undertake effective power system studies in order to understand how their generating unit is likely to perform once connected to the power system. Effective power system studies are central to enabling efficient connection of generators, while also supporting the reliable and secure performance of the power system.

The Commission therefore considers that where AEMO requires this type of model data to be provided (in accordance with the requirements of the NER, as well as the more specific circumstances set out in the guidelines and data sheets), registered participants should also be able to request access to this model data for the purposes of undertaking power system studies.

244 ENA submission, 1 August 2017, p. 3

245 Ibid., p. 5

246 Ibid., p. 5

247 Ibid., p. 5

248 Ibid., p. 5

In reaching this decision, the Commission has been advised by stakeholders and expert advice provided by AECOM that encryption and "black boxing" is capable of providing sufficient protection of intellectual property.

However, the Commission also recognises that some OEMs may still have reservations about this more detailed model data being made available to third parties.

The final rule therefore imposes a requirement on AEMO to have regard to any requirements to protect the intellectual property and confidential information of third parties, including where those third parties are not registered participants. The final rule also requires AEMO to set out in its guidelines and data sheets when it considers that model data that it has been previously been provided with by a registered participant will be reasonably required by another registered participant.[249] The Commission considers that this approach will help assuage concerns of OEMs regarding release of detailed model data to third parties.

This section sets out the Commission's consideration of this issue, including:

- current arrangements for information sharing
- a proposed approach to the protection of sensitive information

Information sharing and confidentiality in the NER

The Commission understands that, to date, the existing standing data framework in clause 3.13.3 of the NER regarding sharing model data has provided sufficient protection of intellectual property and confidential information.

Under this framework, in relation to the provision of model data, only information that is reasonably required by a registered participant to carry out power system studies can be requested, and any information provided to a registered participant by AEMO under that framework must be treated as confidential information.[250] Confidential information is defined in the rules as:

> "In relation to a Registered Participant or AEMO, information which is or has been provided to that Registered Participant or AEMO under or in connection with the Rules and which is stated under the Rules, or by AEMO, the AER or the AEMC, to be confidential information or is otherwise confidential or commercially sensitive. It also includes any information which is derived from such information."

The obligations related to the use of confidential information is further described in rule 8.6 of the NER. In summary, registered participants are not permitted to:

- disclose confidential information to any person except as permitted by the Rules,
- use or reproduce confidential information for purposes other than it was disclosed or another purpose contemplated by the Rules,
- allow unauthorised persons to have access to confidential information.[251]

249 See clause 3.13(k1) of the final rule.

250 See clause 3.13(k)(2) of the NER.

251 See clause 8.6.1 (b) of the NER.

The relevant clauses in the NER under which the first two obligations arise are classified as civil penalty provisions.

Protection of intellectual property

The Commission received advice from AECOM regarding approaches to protecting sensitive information.

Box 3.5 AECOM advice: protection of model data[252]

As part of the advice it provided to the Commission, AECOM noted that various software simulation products allow "black-boxing" or encryption of model data in order to provide protection of intellectual property contained by the design of control and protection system of generating units.

This is normally related to non-synchronous, power electronic connected generators.

AECOM advised the Commission that once a control system model is black-boxed, the details are completely concealed and not observable by its user. Back solving and deriving the model source code from an encrypted model without further information about transfer block diagrams would not be reasonably practical after that point.[253]

AECOM also advised that there are different ways model data may be encrypted. A complete black box would only show inputs and output of a model and no ability to see or tune parameters within the model. Where tuning of the model is required however, it would be possible for suppliers to provide a slightly more flexible black box model which would provide the user with access to the model parameters (only) for the purposes of tuning.[254]

In meetings with various stakeholders, the Commission also sought advice as to whether any examples have arisen where EMT-type models have been back solved (or "reverse engineered") to access commercially sensitive information. The Commission was not advised of any examples where this has occurred.

Handling detailed model information

The Commission is of the view that existing provisions in the NER have so far provided sufficient protection of intellectual property in the NEM and considers that access to accurate model data by network service providers and other registered participants is necessary to conduct power system simulations with sufficiently accurate results.

As discussed in sections 3.1 of this final determination, the accuracy of model data depends on the detail of the relevant model and the system conditions it is applied to. A generator planning to connect to a part of the network with low system strength may require more detailed, EMT-type models of other generators in its proximity in order to correctly assess and design the settings on its equipment. In such cases, the correct

252 AECOM, EMT and RMS model requirements, 23 May 2017. A copy of AECOM's report is available at www.aemc.gov.au

253 Ibid., p. 13

254 Ibid., p. 3

assessment of generator performance standards may also necessitate access to EMT-type modelling of the surrounding power system.

However, given that OEMs may have some reservations regarding the release of more detailed model data, the Commission considers that there may be circumstances where it would be appropriate to restrict the provision of this information, or the format in which it is provided, or the conditions upon which it is provided. However, the Commission notes that model data provided under the model data provision framework must be provided to AEMO and network service providers with the understanding that it may be shared at a later point with other registered participants under the standing data framework, while it continues to be confidential information. Therefore, the Commission is of the view that non-disclosure agreements required by third parties do not supersede the obligations placed on registered participants under the NER.

Conditions may refer to the network conditions in which registered participants requesting the information are located. Therefore, apart from network service providers and AEMO, other registered participants should only have access to EMT-type model data where reasonably required to carry out those more detailed power system studies necessary for their connection. For example, this may be the case if they propose to locate in a weaker part of the network, which necessitates the use of such detailed model data. This approach also helps sharing model data on a need to know basis.

The final rule therefore introduces a requirement for AEMO to set out in the guidelines the circumstances in which AEMO will consider the information requested under clause 3.13.3(k) to be "reasonably required" by the registered participant.[255]

The final rule also includes a principle for AEMO, when developing the guidelines and data sheets, to have regard to any requirements to protect the intellectual property and confidential information of third parties, including where those third parties are not registered participants.[256]

These amendments to the NER will allow AEMO to differentiate between different types of model data. This could include AEMO differentiating between RMS-type and EMT-type model data and only allowing the different kinds of model data to be released where AEMO considers it is reasonably required by the requesting registered participant.

The Commission considers that encryption, or the process referred to as “black boxing” referred to in Box 3.3, is one approach that AEMO could use to meet this obligation to protect intellectual property. As discussed above, this process of encryption completely conceals the details of control system models and make it impractical for any third party to back solve and derive the native model source code.

The Commission understands that AEMO may make use of different types of model data encryption methods to protect the intellectual property of original equipment manufacturers.

255 See clause 3.13.3(k1) of the final rule.

256 See clause S5.5.7(c)(2) of the final rule.

AEMO may be able to require a registered participant to provide it with a "flexible black box" in which model parameters may be differently tuned for the purposes of conducting power system simulation studies. AEMO may also require, from a registered participant, a completely black boxed model that only shows the inputs and the outputs of a model. AEMO may then, in order to protect the intellectual property of third parties, choose to provide other registered participants with a completely black boxed model and use the flexible black box for its own studies only.

Because the development of the revised guidelines and data sheets must be conducted in accordance with the rules consultation procedures, this will enable all interested parties to be consulted on the appropriate requirements to be included in the guidelines and data sheets, and the appropriate circumstances in which such detailed, and potentially commercially sensitive information should be shared amongst registered participants.

Clarifying confidentiality arrangements

The draft rule required AEMO to specify in its guidelines whether it will treat any of the information provided to it as confidential information.[257]

The draft rule did not place an explicit obligation on AEMO, and where applicable, network service providers to treat the information they receive under the model data provision framework as confidential information.

Following the publication of the draft determination, the Commission undertook further consultation with stakeholders on the issue of model data confidentiality. The Commission understands that the standing data framework and current confidentiality provisions of the NER provide appropriate protection for the intellectual property of third parties, including OEMs.

The Commission considers that such protection of confidential model data is better addressed in the NER, in order to provide greater clarity for parties that are required to submit model data to AEMO and network service providers.

Therefore the final rule removes the clause that required AEMO to specify in its guidelines, whether it will treat any of the information submitted to it as confidential information. The final rule also explicitly requires AEMO and network service providers to treat the information they receive under the model data provision framework as confidential information.[258]

Early access to model data

Ergon and Energex suggested that if connection applicants are not considered by AEMO to be intending participants at an early stage of the connection process, that could prevent them from having access to the relevant model data of other proponents that are connected, or are in the process of establishing a connection to the network.[259]

Ergon and Energex also proposed to include an exception in the confidentiality-related provisions of the NER to include an exception for black boxed encrypted EMT-type

257 See clause S5.5.7(b1)(7)(ii) of the draft rule.

258 See clauses 4.3.4(q), 5.2.3(l), 5.2.3A(c), 5.2.4(e), and 5.2.5(f) of the final rule.

259 Ergon and Energex submission, 1 August 2017, p. 5

models and information. [260] The effect of such an exception would have been that black-boxed EMT-type model data is no longer classified as confidential information.

The Commission understands that having access to other registered participants' model data via the standing data framework supports the efficient and timely conclusion of the connection process for connection applicants. However, the standing data framework may only be used by registered participants, and therefore, can only be used by connection applicants once AEMO grants them the status of intending participant.[261] Connection applicants may only be registered by AEMO as an intending participant, if they are able to reasonable satisfy AEMO that they intend to carry out an activity in respect of which they must or may be registered as a registered participant.[262]

AEMO provides guidance on the type of evidence it looks at for its merit-based assessment of whether the applicant can be considered as an intending participant. Such evidence includes:[263]

- board approved business plan
- planning permits
- development approval
- evidence of project funding/finance
- copy of the certificate of title for the land
- copy of the connection inquiry or the connection application
- environmental impact assessment studies
- press releases
- evidence that the development process has been commenced
- project milestones - construction to typically commence within a reasonable period of time from registering as an intending participant.

Furthermore, AEMO advises that applicants should note that AEMO does not require all of the above, rather that applicants should provide as much as they can, given the stage of development of their project.[264]

The Commission considers that AEMO's requirements indicate that connection applicants may only become intending participants, once their development project reaches a reasonably mature stage. The Commission is of the view that the current

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260 Ibid., p. 5

261 By definition, intending participants are "registered participants" and, therefore, are eligible to use the standing data framework in clause 3.13.3.

262 See rule 2.7(a) of the NER.

263 See: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Participant-information/New-participants/Intending-Participants

264 See: https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Participant-information/New-participants/Intending-Participants

arrangements for AEMO's discretion in deciding at what stage of the connection process a connection applicant may be granted intending participant status remain appropriate.

The Commission also considers that it would not be appropriate to include connection applicants (who are not yet registered participants) in the standing data framework as they are not bound by the same obligations as registered participants, including confidentiality obligations.

The Commission notes that the standing data framework is intended to protect the intellectual property and confidential information of third parties. The final rule requires registered participants to provide model data in encrypted format, and model data may be shared only in a compiled, encrypted or any other secured format under the current standing data framework.[265] The Commission is of the view that by providing model data in an encrypted format, under the model data provision framework, registered participants understand that their data may be shared with other registered participants under the standing data framework.[266]

The Commission considers that exempting any type of encrypted models from the confidentiality obligations of registered participants[267] would circumvent the standing data framework and consequently would not provide appropriate protection for intellectual property and confidential information disclosed under the model data provision framework. Therefore the Commission considers that the suggestion of exempting black boxed encrypted EMT-type models and information would not be appropriate.[268]

265 See clause 3.13.3(l)(2).

266 Subject to confidentiality arrangements required by the NER.

267 See rule 8.6 of the NER.

268 Ergon and Energex submission, 1 August 2017, p. 5

Abbreviations

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
Commission	See AEMC
COAG	Council of Australian Governments
EMT	electromagnetic transient
MCE	Ministerial Council on Energy
NEL	National Electricity Law
NEM	national electricity market
NER	National Electricity Rules
NEO	national electricity objective
NSCAS	network support and control ancillary services
RMS	root mean square
SVC	static VAR compensator
SRAS	system restart ancillary services
STATCOM	static synchronous compensator

A Summary of other issues raised in submissions

A.1 Summary of other issues raised in submissions to the consultation paper

This appendix sets out the issues raised in the first round of consultation on this rule change request and the AEMC's response to each issue. If an issue raised in a submission has been discussed in the main body of the draft determination, it has not been included in this table.

Stakeholder	Issue	AEMC Response
Alinta Energy, p. 4.	Alinta noted that tests that may be initiated by AEMO or an NSP under 5.7.6 of the NER may happen too frequently (once a year) and, therefore, may put "undue burden on a generator".	The Commission considers that this is a separate issue that is not closely related to the rule change request. Therefore, it should be addressed through a separate rule change request.
DIgSILENT, p. 3	DIgSILENT was of the view that 5.4.3, 5.4.4 and S5.5.2 of the NER provide sufficient rights to the relevant NSP to require additional model data if it deems necessary.	5.4.3 and 5.4.4 of the NER relate to the establishment or modification of embedded generation, therefore, they only allow NSPs to require additional information from embedded generators, and not from other generators that tend to be more relevant for the security of the power system. While S5.5.2 of the NER states that an NSP "may, in cases where there is reasonable doubt as to the viability of a proposal, require the submission of other data before making an offer to connect or to amend a connection agreement", this only allows for the provision of model data at the time of negotiating a connection agreement, and not in other cases.

A.2 Summary of other issues raised in submissions to the draft determination

This appendix sets out the issues raised in the second round of consultation on this rule change request and the AEMC's response to each issue. If an issue raised in a submission has been discussed in the main body of this document, it has not been included in this table.

Stakeholder	Issue	AEMC Response
Ergon and Energex, p. 8	Ergon and Energex were concerned that the proposed commencement date is too distant and a significant number of connection enquires and applications from renewable non-synchronous power electronic interfaced generators would not be covered by the new rules. They suggested the inclusion of a transitional period when EMT-type models could be required from proponents by network service providers.	The Commission acknowledges the importance of timely commencement of this rule change and the number of development projects that would be affected by the rule change. Therefore, the Commission decided to require AEMO to develop and publish the amended guidelines and data sheets by 1 July 2018. The Commission considers that a transitional period would not be appropriate in this case, as the relevant requirements and circumstances for the model data provision framework are to be specified in the new guidelines and data sheets.
Ergon and Energex, pp 8-9	Ergon and Energex submitted that clause 3.13.3(k)(2) should be amended to refer to power system simulation studies in order to be consistent with the draft rule.	The Commission agrees with the suggestion and inserted a reference to "simulation". It did not however replace the words "load flow and dynamic simulations" because these words are prefaced by "including", which therefore does not limit the information to load flow and dynamic simulation.
ENA, p. 2	ENA members considered it is appropriate that modelling requirements of many small generators collectively participating in the market via a small generation aggregator be addressed by this rule change.	The Commission notes that small generators remain the connection applicant through the connection process and remain the responsible person for providing model data to AEMO and the relevant network service provider pursuant to the model data provision framework. Furthermore, the relationship between the small generation aggregator and its small generators that is recognised by the NER does not relate to the scope of this rule change request.
ENA, p. 3	ENA was of the view that final rule must clearly state that the responsibility rests with the proponent to	The Commission considers that the final rule clearly requires participants to comply with the guidelines, and therefore, they have an

Stakeholder	Issue	AEMC Response
	provide the model to AEMO in the correct format. The descriptor of the model provided must include the version number of the software/firmware.	obligation to comply with the requirements of the guidelines, which will set out what types of models and formats and versions are required. Furthermore, the Commission notes that such level of detail is better addressed in the guidelines and not in the NER.
ENA, p. 3	ENA suggested that generators should positively comply with the model accuracy and verification requirements during the connection process. It further added that given the importance of power system security in a changing generation environment, industry could consider moving to a revised obligation where the provision of this design information by a registered participant or new generator is to be provided to the relevant network service provider at the time of the signing of a connection agreement.	The Commission is of the view that the final rule provides an appropriate framework for network service providers the request sufficiently detailed information from registered participants if that is required for them to meet their obligations under the NER. In addition the Commission considers that the NER does not prevent network service providers from obtaining registered data from connection applicants, as clause 5.8.3(a) of the NER states that information required to assess the connection must be provided not less than three months prior to the proposed commencement of commissioning. Furthermore, the Commission notes that the NER currently allows network service providers to negotiate the relevant milestones with connection applicants that set out the specific times and deadlines for the connection process. Taking into account the variety of circumstances that may influence the formation of such milestones, the Commission considers that the level of prescription in the final rule should not be further increased.
ENA, p. 3	ENA urged the Commission to ensure the current rule change determination is cognisant of, and consistent with, a number of related rule changes, technical and policy reviews, including an impending AEMO rule change on technical standards and the Finkel Report's recommendation on connection standards.	The Commission notes that it takes into account the relevant regulatory framework while considering rule change proposals.

Stakeholder	Issue	AEMC Response
ENA, p. 4	ENA suggested the following: The final rule should require that updates to any software/firmware for each connection must be provided to AEMO 15-business days prior to the change. It should be the responsibility of the relevant generator to test the update or re-model the connection, rather than AEMO. While AEMO would not be obligated to approve the change, should the generator, or the NSP subsequently identify that the change has caused any 'non-compliance', the generator must clearly remedy the situation.	The Commission understands that an update to firmware or software for a generator constitutes a proposed alteration to a generating system. Clause 5.3.9 of the NER already sets out the procedure that should be followed in such a case, and requires generators to provide specific information in accordance with the guidelines and data sheets about proposed alteration.
ENA, p. 4	ENA suggested that the AEMC should consider AEMO's advice to the Essential Services Commission of South Australia with regards to the Recommended Technical Standards for Generator Licensing in South Australia.	The Commission notes that it has received a rule change request from AEMO with regards to technical standards for generators and will consider the issues raised in that rule change request in that rule change.
ENA, p. 4	ENA sought clarity whether the AEMC's determination and rule places clear responsibility upon AEMO to become the repository/custodian of the PSCAD/EMTDC models, similar to the structure in place surrounding the PSS/E models, which enables and facilitates the sharing of models to the relevant stakeholders and parties.	The Commission notes that the standing data framework described in 3.13.3 remains applicable in relation to information provided under the model data provision framework and AEMO. In addition, the final rule requires AEMO to set out in the guidelines the circumstances it will consider the information to be reasonable required by a registered participant. The Commission expects that such circumstances will be determined in the guidelines in order to reflect the necessary detail required for conducting power system simulation studies in specific power system conditions.
ENA, p. 5	ENA recommended that the effective date of the proposed rule should be brought back to 1 July 2018 in order to cover the large number of projects that	See response to Ergon and Energex's similar recommendation.

Stakeholder	Issue	AEMC Response
	are currently proposing to connect. It also suggested that interim guidelines should be in place for the transitional period between the end of 2017 or the first quarter of 2018 and 1 July 2018.	
AEC, p. 1	The Australian Energy Council was concerned that the assessment of benefits to be obtained from the proposed rule change has been limited to qualitative statements from AEMO and the AEMC has not conducted a quantitative cost-benefit analysis.	Given the technical complexity of some of the issues contained in the rule change request, the Commission sought independent advice from AECOM, a firm with technical experience in the development and assessment of model data and power system studies. The advice provided by AECOM gave an indication of the order of magnitude of costs that could be associated with new compliance obligations stemming from the rule change. The Commission understands that it would be difficult to quantify the benefits of allowing access to more accurate model data in the NEM, as it would include exercises such as estimating the price and value of system security. The Commission is of the view that because the final rule requires AEMO to have regard to the reasonable costs of efficient compliance by registered participants, the appropriate balance of costs and benefits will be maintained in its implementation.
Basslink, p. 2	Basslink contended that there is a tendency for Basslink to become a “party of first resort” when neighbouring TNSPs are experiencing technical problems.	The Commission notes that registered participants are required to provide information to AEMO and network service providers in accordance with the NER, the guidelines and the data sheets. If a registered participant is required to provide more than the regulatory framework would allow, it should raise the issue with the Australian Energy Regulator.
Basslink, p. 2	Basslink contended that it already provides services to the market that it does not receive compensation for. It added that the according to AEMO the value of such service is in excess of $1 million.	The Commission notes that assessing the issue of a registered participant being required to provide services without compensation is not within the scope of this rule change.

Stakeholder	Issue	AEMC Response
AEMO, p. 5	AEMO contended that because EMT-type models are generally a one-to-one translation of the actual control source code without the need for user intervention, EMT-type models would be easier to produce compared to the RMS-type models, which may require a complete user written model implementation necessitating extra time and effort.	The Commission is of the view that the development of models depend on a range of factors and EMT-type models are more complex and detailed than RMS-type models. The Commission understands that while in some cases the development of EMT-type models may less difficult than RMS-type models, it will not be the case for the majority of cases.
AEMO, p. 6	AEMO considered that the costs and timeframes of developing EMT-type models quoted in the AECOM report are incorrect by an order of magnitude. It was of the view that such models could be developed in a shorter timeframe and cheaper than it was suggested in the report.	The Commission acknowledges that there may be differing views in the industry regarding the costs and the timeframes associated with the development of EMT-type models. This is why the Commission sought independent advice from a consultant firm with technical experience in the development and assessment of model data and power system studies.
ENGIE, p. 2	ENGIE noted that a significant component of the costs associated with the provision of modelling data can arise from the need to perform power system tests to confirm the accuracy of models. ENGIE added that such testing activities can have an adverse effect on the condition of generating plant and can introduce an increased risk of damage to plant infrastructure. It expressed its wish to include a specific reference to testing as part of AEMO's reasonable costs considerations in clause S5.5.7(c).	The Commission notes that S5.5.7(c)(1) of the final rule requires AEMO to have regard to the reasonable costs of efficient compliance by registered participants while developing the guidelines and data sheets. S5.5.7(b1) (2) of the final rule requires the guidelines to specify the model accuracy requirements that are applicable to each type of model provided. Further, section 5.3 of the current guidelines contains the validation requirements and it states that each model must be developed and tested to the extent reasonably necessary to establish that it will meet the accuracy requirements described for the relevant model type. Therefore, the Commission is of the view that the costs associated with the testing of the model constitute an integral part of the costs of developing that model. Consequently, such costs must be taken into account when AEMO is considering the reasonable costs of effective compliance pursuant to S5.5.7(c)(1) of the final rule.
DIgSILENT, p. 3	With regards to the ERCOT study referenced in the	The Commission agrees that an explicit "blanket requirement" that

Stakeholder	Issue	AEMC Response
	draft determination, DIgSILENT was of the view that it supported its thesis that RMS simulations using accurate RMS models are generally adequate and that a blanket requirement for EMT studies may be too severe. It added that the study confirmed that all models should be thoroughly validated.	would oblige all market participants to submit EMT-type models to AEMO and NSPs would not have been appropriate for this rule change. Therefore, the final rule requires the guidelines to specify guidance on the factors that AEMO will take into account when determining the circumstances under which AEMO will request information to be provided, including the power system conditions that necessitate the usage of a certain type of model in order to achieve the desired level of accuracy. The Commission notes that section 5.3 of the current guidelines already contains the validation requirements of models.
DIgSILENT, p. 1	DIgSILENT noted that there are different limitations associated with using specific software packages as well as with using RMS or EMT-type models. It further contended that it cannot be assumed that an EMT-type model is less or more accurate than an RMS model without thorough validation of both	See above.
DIgSILENT, p.2	DIgSILENT contended that the following statement in the draft determination is incorrect or incomplete: “RMS-type models represent the voltages and currents variables in the power system as balanced 3-phase sine waves with a magnitude and phase angle”. DIgSILENT provided the following comment with regards to this statement: “RMS refers to the fact that a sinewave phasor is represented by a vector with magnitude and phase angle. RMS does not imply that the model should be otherwise simplified into a balanced system or even that the system should be limited to three-phase systems. RMS simulations can also be conducted using unbalanced modelling and simulation for systems	The Commission agrees that although in most cases RMS-type models assume that the three phases are balanced, this may not always necessarily be the case. The final determination took into account DIgSILENT's submission, accordingly.

Stakeholder	Issue	AEMC Response
	with any number of phases. This is however software dependent and several RMS software packages are commercially available that offer full three-phase modelling and the capability of simulating unbalanced systems."	
DIgSILENT, p. 2	DIgSILENT contended that the following statement in the draft determination is incorrect or incomplete: "However, RMS-type models are not always capable of accurately modelling non-synchronous generating systems and how such equipment may interact with each other when there is low system strength". DIgSILENT provided the following comment with regards to this statement: "This is a vague statement and should be clarified and quantified to be able to understand the actual problem. It is our experience that some models are simplified in the RMS domain but it need not always be the case. It is possible to obtain good results by modelling the phase locked loops and linkages with current controllers in the RMS domain. It is really only in extreme operating conditions that it is essential to model sub-systems of the network in EMT fidelity."	The Commission is of the view that the greater detail of EMT-type models allows for more accurate modelling non-synchronous generating systems and how such equipment may interact with each other when there is low system strength.
DIgSILENT, p. 2	DIgSILENT contended that the following statement in the draft determination is incorrect or incomplete: "Unlike RMS-type models, EMT-type models provide the means to simultaneously and accurately assess all three phases in the power system." DIgSILENT provided the following comment with regards to this statement: "This is not correct. RMS models can also assess all three phases in a power system. However, not all RMS software platforms	The Commission agrees that this statement should be further clarified in the final determination. The Commission is of the view that RMS-type models are only capable of modelling three phases to the extent that they can be represented by sine waves.

Stakeholder	Issue	AEMC Response
	have this capability, but this is not a limitation of RMS modelling technology."	
DIgSILENT, p. 3	DIgSILENT asked the following question it its submission: "The primary use of EMT models is to examine the electro-magnetic transient behaviour of the plant. If the aim for the power system simulation is to capture fast dynamic controls, full three phase RMS models with shorter simulation time steps is generally sufficient. This approach can optimize the need for both accuracy and efficiency. In fact, modern analysis tools can vary the time step according to the situation, which will deliver even better efficiencies in the conduct of studies. Has this approach been attempted by AEMO?"	The Commission considers that this question would be better addressed to AEMO during the rules consultation procedure when it is developing the revised guidelines and data sheets. However, the Commission notes that using three phase models with shorter time steps would improve the accuracy of the controls, but could not capture electromagnetic transients with transformers, transmission lines and other equipment which may be material under some conditions.
DIgSILENT, p. 3	DIgSILENT asked the following question it its submission: "Would the inaccuracies introduced by an unknown dynamic load model (which is constantly changing and gaining dynamic characteristics) as well as other system modelling assumptions invalidate the benefit of grid-wide EMT simulations?"	The Commission considers that this question would be better addressed to AEMO during the rules consultation procedure when it is developing the revised guidelines and data sheets. However, the Commission notes that while this may be the case, it could be mitigated better load models and modelling of various conditions.
DIgSILENT, p. 3	DIgSILENT asked the following question it its submission: "If there is a need to examine the EMT interaction between inverters, all inverters within a generating system have to be modelled individually as they are electrically closer to one another than inverters from another farm. More importantly the inverters electrically closest to the grid connection point may behave differently to those far removed	The Commission considers that this question would be better addressed to AEMO during the rules consultation procedure when it is developing the revised guidelines and data sheets. However, the Commission notes that such a task would be computationally demanding, but may only be required in certain circumstances.

Stakeholder	Issue	AEMC Response
	from the grid connection (but within the same generating facility) due to the additional impedance between these inverters. Would AEMO be able to conduct such detailed network simulations in an EMT environment within practical time periods?"	
DIgSILENT, p. 3	DIgSILENT asked the following question it its submission: "All power system models rely on modelling assumptions. If a wide area EMT simulation study uses aggregate wind and solar farm models, this represents yet another assumption which may qualify the accuracy of the study results. Are there any local measurements that validate the EMT simulation results under the low system strength conditions that are of concern?"	The Commission considers that this question would be better addressed to AEMO during the rules consultation procedure when it is developing the revised guidelines and data sheets. However, the Commission notes that such an issue could be addressed by modelling a range of wind and solar conditions.

B Legal requirements under the NEL

This appendix sets out the relevant legal requirements under the NEL for the AEMC to make this final rule determination.

B.1 Final rule determination

In accordance with section 102 of the NEL the Commission has made this final rule determination in relation to the rule proposed by AEMO.

The Commission's reasons for making this final rule determination are set out in section 2.3.

A copy of the final rule is attached to and published with this final rule determination. Its key features are described in section 2.4.

B.2 Power to make the rule

The Commission is satisfied that the final rule falls within the subject matter about which the Commission may make rules. The final rule falls within section 34 of the NEL as it relates to the operation of the national electricity market, the operation of the national electricity system for the purposes of the safety, security and reliability of that system, and the activities of persons (including registered participants) participating in the national electricity market or involved in the operation of the national electricity system.

Further, the final rule falls within the matters set out in schedule 1 to the NEL as it relates to the operation of generating systems, transmission systems and distributions systems, and to confidential information held by AEMO and registered participants and the manner and circumstances in which that information may be disclosed.

B.3 Additional rule making test - Northern Territory

From 1 July 2016, the NER, as amended from time to time, apply in the Northern Territory, subject to derogations set out in regulations made under the Northern Territory legislation adopting the NEL.[269] Under those regulations, only certain parts of the NER have been adopted in the Northern Territory.[270]

The National Electricity (Northern Territory) (National Uniform Legislation) Act 2015 allows for an expanded definition of the national electricity system in the context of the application of the NEO to rules made in respect of the Northern Territory, as well as providing the Commission with the ability to make a differential rule that varies in its terms between the national electricity system and the Northern Territory's local electricity system.

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269 Refer to National Electricity (Northern Territory) (National Uniform Legislation) (Modification) Regulations

270 For the version of the Electricity Rules that applies in the Northern Territory, refer to: http://www.aemc.gov.au/Energy-Rules/National-electricity-rules/National-Electricity-Rules-(Northern-Territory)

The Commission has considered whether a differential rule is required for the Northern Territory electricity service providers and concluded that it is not required in this instance. This is because the provisions of the final rule either:

- have no application in the Northern Territory because they relate to provisions of the National Electricity Rules that do not apply in the Northern Territory (Chapters 3, 4 and 5); or
- have no practical effect in the Northern Territory because although they relate to chapters that do apply in the Northern Territory (Chapters 10 and 11), the changes to those chapters relate only to provisions that have no application in the Northern Territory (e.g. definitions only used in provisions of Chapters 3, 4 and 5 that do not apply in the Northern Territory).

B.4 Commission's considerations

In assessing the rule change request, the Commission considered:

- its powers under the NEL to make the rule;
- the rule change request;
- submissions received during first and second rounds of consultation; and
- the Commission's analysis as to the ways in which the proposed rule will or is likely to, contribute to the NEO.

There is no relevant Ministerial Council on Energy (MCE) statement of policy principles for this rule change request.[271]

The Commission may only make a rule that has effect with respect to an adoptive jurisdiction if satisfied that the proposed rule is compatible with the proper performance of AEMO's declared network functions.[272] The final rule is compatible with AEMO's declared network functions because it enhances the proper performance of those functions.

B.5 Civil penalties

The final rule amends one clause that is currently classified as civil penalty provision under the NEL or National Electricity (South Australia) Regulations. Clause 5.3.4A(e) is amended by this rule and is currently classified as a civil penalty provision. The Commission will consult with the AER regarding whether this clause should continue to be classified as a civil penalty provision, and following consultation will make a recommendation to the COAG Energy Council.

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271 Under section 33 of the NEL the AEMC must have regard to any relevant MCE statement of policy principles in making a rule. The MCE is referenced in the AEMC's governing legislation and is a legally enduring body comprising the Federal, State and Territory Ministers responsible for Energy. On 1 July 2011 the MCE was amalgamated with the Ministerial Council on Mineral and Petroleum Resources. The amalgamated council is now called the COAG Energy Council.

272 Section 91(8) of the NEL.