Australian Energy Market Commission

AEMC

RULE CHANGE

DRAFT RULE DETERMINATION

National Electricity Amendment (Generating System Model Guidelines) Rule 2017

Rule Proponent

Australian Energy Market Operator

20 June 2017

Inquiries

Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

E: aemc@aemc.gov.au
T: (02) 8296 7800
F: (02) 8296 7899

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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.

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Summary

The Australian Energy Market Commission (AEMC or Commission) has made a draft 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 and the development of generator performance standards.

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 draft 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 draft rule expands the existing NER frameworks for model data provision

The draft rule amends the existing framework in the national electricity rules (NER) to clarify the circumstances and conditions under which parties must provide model data to AEMO and where relevant, network service providers.

The draft rule requires AEMO to set out, in its model guidelines and data sheets, the technical and operational details of what model data will be required by participants and the specific circumstances or conditions under which that model data will be required.

The draft rule also sets out principles that AEMO must consider when it develops the guidelines and data sheets. This includes a requirement for AEMO to consider the costs faced by participants in providing model data and the protection of confidential model information.

In making the draft 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.

In making the draft rule, the Commission has sought to strike an appropriate balance in terms of the function of the NER against the function of AEMO's generating system model guidelines and data sheets.

Background and rationale

Changes in the power system, particularly a reduction in system strength in some areas, mean that more detailed 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 smaller generators, transmission network service providers, distribution network service providers, market network service providers, or customers on the transmission or distribution networks.

Less accurate models may lead to less accurate power system studies, which in turn means that AEMO and network service providers may not be able to accurately determine how generators and the power system more generally are likely to behave under certain conditions. This may in turn 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 result in an insecure power system and potentially an increase in the risk of cascading failure.

Because the NER do not currently explicitly specify what kind of model data must be provided in all required circumstances, there is potential for some uncertainty about what type of models are sufficient for registered participants to meet their obligations.

The AEMC published a consultation paper on the rule change request, and this draft determination is informed by stakeholder submissions on that consultation paper.

Features of the draft rule

The draft rule reflects the rule proposed by AEMO with some consequential amendments to reflect the Commission's approach to key issues.

The draft rule expands the application of the existing model data provision framework to apply to additional types of participants, plant and equipment. This will enable AEMO and where relevant, network service providers, to access model data for equipment owned by these participants which is needed for accurate power system studies.

A key aspect of the draft rule is that AEMO will be required to specify certain information in the guidelines and data sheets, including:

- what type of model data it will require from different participants
- the model accuracy requirements that are applicable to each type of model provided, and

- the circumstances in which it will require the different types of model data.

The draft rule also requires AEMO to have regard to the costs participants will face while complying with the model data provision requirements and to use reasonable endeavours to accept a range of software simulation products and versions. The Commission understands that there are various software products that allow for the development of EMT-type models; requiring AEMO to accept models provided in different formats will help participants to manage costs by allowing them to elect the software format they consider to be most cost effective.

Additionally, the draft rule requires AEMO to have regard to the sensitivity of highly detailed model data and therefore to set out in its guidelines the circumstances in which this model data may be shared with third parties.

How the draft rule meets the National Electricity Objective

Having regard to the issues raised in the rule change request, the Commission is satisfied that the draft 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 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.

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 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[1] 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 information by generators to AEMO and where relevant, network service providers (referred to throughout this draft determination as the NER model data provision framework).[2]

The NER also establish arrangements for registered participants to access some of this information, in the form of encrypted model data, in order to perform power system

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1 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.

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

studies (referred to throughout this draft determination as the standing data framework).

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 providers, 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.[3]

AEMO or the relevant network service provider can also 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.[4]

In addition, 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.[5]

Generators are required to provide modelling data to AEMO in both an encrypted and a non-encrypted format.[6]

Under the standing data framework, a registered participant may request from AEMO the encrypted model data previously submitted to AEMO,[7] where that information is reasonably required by the registered participant to carry out their own power system studies.[8] Any information provided to a registered participant by AEMO under that framework must be treated as confidential information.[9]

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

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

5 See clause 5.3.9 of the NER.

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

7 For example, the encrypted model data provided by generators as part of their connection process.

8 See clause 3.13.3(k) of the NER.

9 See rule 8.6 of the NER.

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.[10]

Parties tendering to provide network support and control ancillary services (NSCAS) 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 network support and control ancillary service.[11]

Generators that connect generating units equal to or less than 30MW to a connection point to a distribution network are also required 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.[12]

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[13] in some areas, mean that more detailed power system studies are required to understand how the power system will function under certain conditions.[14] 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

10 See clause 3.11.9(g) of the NER.

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

12 See clause S5.5.6 of the NER.

13 See section 3.1.3

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

detail sufficient to undertake effective power system studies, given changes to the power system such as reduced levels of system strength.[15]

- 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.[16]
- 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.[17]

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:[18]

- 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 draft 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

15 Ibid., pp. 5-6

16 Ibid., p. 4

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

18 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 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. 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.

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 when 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, than currently accounted for under the existing NER model data provision framework.
- an increased level of detail means having access to more detailed model data reflecting the technical operation of generating and protection equipment, typically through the provision of more detailed EMT-type models, than is currently specified in the existing NER model data provision framework.[19]

Scope of information to be provided

AEMO's proposed rule expanded the NER model data provision framework to include 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

19 The difference between RMS and EMT models is explained in Box 1.1

Design Data Sheet, Power System Setting Data Sheet and Power System Model Guidelines.[20]

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.[21]

As such, the proposed rule provided AEMO with 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.[22]

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 would allow it to operate and plan the power system more effectively:

20 AEMO, rule change request, p.30

21 AEMO, rule change request, 31 October 2016, p. 7

22 Ibid., p. 7

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

  For example, more detailed EMT-type models would allow AEMO 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.[23] This would allow for the negotiation of more effective generator performance standards.[24]

- **More effective power system operation:** AEMO considered that it could conduct better power system studies if it had access to more detailed model data. This would allow for the formulation of more accurate constraint equations to support more efficient operation of the power system.[25] 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.[26]

- **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 data 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 would 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.[27]

AEMO also 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.[28] 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.

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23 Ibid., p. 15

24 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.

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

26 Ibid., p. 6

27 Ibid., p. 7

28 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.

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.[29]

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.[30]

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.[31]

As such, in some instances, existing registered participants could be required to provide additional model data in relation to existing plant. 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.[32] A consultation paper identifying specific issues for consultation was also published. Submissions closed on 12 April 2017.

The Commission received 13 submissions as part of the first round of consultation. The Commission considered all issues raised by stakeholders in submissions. Issues raised in submissions are discussed and responded to throughout this draft rule determination.

Issues that are not addressed in the body of this document are set out and addressed in Appendix A.

29 Ibid., p. 6

30 Ibid., pp. 6, 8

31 Ibid., p. 13.

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

1.6 Consultation on draft rule determination

The Commission invites submissions on this draft rule determination, including a draft rule, by 1 August 2017.

Any person or body may request that the Commission hold a hearing in relation to the draft rule determination. Any request for a hearing must be made in writing and must be received by the Commission no later than 27 June 2017.

Submissions and requests for a hearing should quote project number ERC0219 and may be lodged online at www.aemc.gov.au or by mail to:

Australian Energy Market Commission
PO Box A2449
SYDNEY SOUTH NSW 1235

2 Draft rule determination

The Commission has decided to make a draft rule as proposed by AEMO, with some consequential amendments to reflect the Commission's approach to key issues.

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

The draft rule seeks to:

- utilise the existing NER model data provision framework wherever possible, by clarifying how that framework applies to various market participants, and imposing clear guiding principles on AEMO in undertaking its obligations in relation to 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.[33]

The draft rule makes some amendments to 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 draft 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.

The draft rule requires the technical detail of what types of model data must be provided 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 proposed 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.[34] 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.

The Commission considers that the approach it has taken in the draft rule will enable AEMO (and where relevant, network service providers) to access the model data

33 This draft 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. The Commission has generally referred to these documents as "the data sheets" throughout this determination.

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

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 draft rule has been designed to strike an appropriate balance between including high level principles in the NER and clearly setting out the responsibilities of parties in the NER, and 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.[35] 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 draft rule, and provides an explanation of the key differences between its draft rule and AEMO's proposed rule.

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

Appendix C provides a summary of the consequential amendments made to the proposed rule to give effect to the draft rule.

2.1 The Commission's draft rule determination

The Commission's draft rule determination is to make a draft rule as proposed by AEMO, with amendments.

The draft rule:

- broadens the scope of the NER model data provision framework to include non-generating system power system components and specifies the minimum requirements and principles that AEMO must have regard to when developing and amending the guidelines and data sheets
- includes prospective providers of network support and control ancillary services, system restart ancillary services and generators with nameplate capacity less than

35 See rule 8.9 of the NER.

30MW in the NER model data provision framework (i.e. the datasheets and guidelines)

- includes in the NER model data provision framework, the provision of modelling data and information from network users and network service providers
- requires AEMO to develop and publish the revised guidelines and data sheets by 30 September 2018, in accordance with the rules consultation procedure under rule 8.9 of the NER.

The Commission's reasons for making this draft 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 draft rule against the national electricity objective (NEO).

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

2.2 Rule making test

2.2.1 Achieving the national electricity objective

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).[36] This is the decision making framework that the Commission must apply.

The NEO is:[37]

> "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."

2.2.2 Making a differential rule

Under the Northern Territory legislation adopting the NEL,[38] the Commission must regard the reference in the national electricity objective 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:

36 Section 88 of the NEL.

37 Section 7 of the NEL.

38 Section on 32A of the National Electricity (Northern Territory) (National Uniform Legislation) Act 2015.

- the national electricity system
- one or more, or all, of the local electricity systems
- 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.

For this rule change request, the Commission has determined that a differential rule is not required for the Northern Territory. Further information on the reasons is set out in Appendix B.

2.3 Assessment framework and summary of reasons

In assessing the rule change request against the NEO, the Commission considered whether the proposed rule was likely to deliver more efficient outcomes.

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 draft 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 draft rule, the Commission has considered:

- the proportionality of the solutions developed in the draft rule, relative to the materiality of the issue identified
- the potential power system operational benefits associated with the draft 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 draft 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 draft rule. Furthermore, the draft 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 to the general processes followed by generators when deciding where and how to connect a new generator to the power system. It may include 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. 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 draft 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 generator, 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 generators may be better able to identify the optimal location of generation units 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 draft rule may impose some additional costs on participants, there are likely to be net benefits for consumers. Furthermore, the draft rule establishes a framework that the Commission considers will provide predictability 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 draft rule

Having considered the rule change request against the assessment framework set out in section 2.3, the Commission has decided to make a draft rule. The draft rule is published alongside this draft determination.[39] This section describes the draft rule.

The draft rule:

- expands the range of participants that are required to provide model data
- expands the circumstances in which model data is to be provided
- introduces new principles that AEMO must consider when developing and amending the guidelines and data sheets
- requires the guidelines and data sheets to include specific matters
- requires AEMO to set out in the guidelines and data sheets, the circumstances in which it will consider information to be reasonably required by a registered participant under the standing data framework.

These changes are further explained below. The draft rule requires AEMO to develop and publish the revised guidelines and data sheets by 30 September 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.

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

2.4.1 Expanded range of participants

The draft rule expands the range of participants that are required to provide model data to AEMO and network service providers under the existing NER model data provision framework.

The draft rule now expands the scope of the NER model data provision framework so that it explicitly applies to network service providers, NSCAS / SRAS providers, network users[40] and generators smaller than 30MW.

More specifically, the draft 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.
- requires network service providers to provide information and model data to AEMO in accordance with the requirements and circumstances specified in the Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet, if in AEMO's reasonable opinion, there is a risk that an alteration to a network element 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. The information must contain sufficient detail for AEMO to perform power system simulation studies in accordance with those requirements and circumstances specified in the guidelines and data sheets. Models need to be provided in an encrypted format, and where available, in an unencrypted format with the model source code.[41]
- requires network users that wish 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 information about the control systems of the equipment to AEMO in accordance with the requirements and circumstances specified in the Power System Model Guidelines, Power System Design Data Sheet, and Power System Setting Data Sheet. The information must contain sufficient detail for AEMO to perform power system simulation studies in accordance with those requirements and circumstances specified in the guidelines and data sheets. Models need to be provided in an encrypted format, and where available, in an unencrypted format with the model source code.[42]
- requires generators smaller than 30 MW that are intending to connect to the distribution network to provide registered system planning data and registered data in accordance with the requirements specified in the Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet.[43]

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40 A network user who connects any new or additional equipment to a network that is intended to consume or use in excess of 20,000 MWh per annum.

41 See clause 4.3.4(j) of the draft rule.

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

43 See clause S5.5.6 of the draft rule.

- requires a tenderer for NSCAS to provide sufficient data, models and parameters for relevant plant in accordance with the requirements specified in the Power System Model Guidelines, the Power System Design Data Sheet and the Power System Setting Data Sheet, 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.[44]
- requires a prospective SRAS provider to provide to AEMO sufficient data, models and parameters of relevant plant in accordance with the requirements specified in the Power System Model Guidelines, the Power System Design Data Sheet and the Power System Setting Data Sheet, to facilitate a thorough assessment of the network impacts and power station impacts of the use of the relevant system restart ancillary service.[45]

2.4.2 Expanded and specified circumstances

The draft rule clarifies and expands the circumstances in which AEMO may request model data from 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 a new provision that confirms AEMO's ability to request an existing connected generator to provide additional or updated model data, where AEMO considers that this is necessary.[46] The draft 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 network impacts.[47]

The draft rule also 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.[48]

More specifically, the draft rule:

- substitutes references to load flow and dynamic simulation studies with power system simulation studies.
- imposes a new general obligation on generators, which is intended to clarify that AEMO may request additional model data from existing generators. This obligation confirms that generators must provide to AEMO and the relevant network service provider, modelling information of the type described in S5.2.4 (i.e. the type of information provided by a generator when negotiating its connection agreement) in accordance with the requirements and circumstances specified in the Power System Model Guidelines and the Power System Design Data Sheet and Power System Setting Data Sheet.

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44 See clause 3.11.5(b)(5) of the draft rule.

45 See clause 3.11.9(g) of the draft rule.

46 See clause 5.2.5(b)(7) of the draft rule.

47 See clause 5.3.9(a) of the draft rule.

48 See clause 3.13.3(k1) of the draft rule.

- allows AEMO to ask for updated model information where a 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, inter-regional power transfer capability or the use of a network by another network user.[49]
- requires generators to provide model source code, where available in a software simulation product nominated by AEMO.
- requires AEMO to nominate its preferred software simulation products in the Power System Model Guidelines.
- requires AEMO to set out in the Power System Model Guidelines the circumstances in which AEMO will consider the information under clause 3.13.3(k)(2) to be reasonably required by a registered participant.[50]

The draft rule also maintains that AEMO and the network service providers are to treat the model data received from generators as confidential information.[51]

2.4.3 AEMO guideline principles

The draft rule requires AEMO to have regard to new principles when developing and amending the guidelines and data sheets. These principles are intended to minimise the costs for participants in providing model data, and to protect the intellectual property of third parties.

Therefore, the draft rule requires AEMO, when developing and amending the Power System Model Guidelines and Power System Design Data Sheet and Power System Setting Data Sheet to:

- have regard to the reasonable costs of efficient compliance by registered participants compared to the likely benefits from the use of the information,
- use reasonable endeavours to accept a range of software simulation products and versions, and
- 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.[52]

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

50 See clause 3.13.3(k1) of the draft rule.

51 See clause S5.5.7(b1)(7)(ii) of the draft rule. This means that the framework under rule 8.6 would apply to that information.

52 See clause S5.5.7(c) of the draft rule.

2.4.4 Specific matters

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

This is intended to clarify what type of model data will need to be submitted to AEMO and by what type of participants. It also sets out a requirement for AEMO to establish defined requirements for information provision.

The draft rule therefore requires AEMO, when developing, publishing and maintaining the Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet to:

- specify the data and model requirements for power system, control system and relevant plant technologies
- have regard to the purpose of the guidelines and data sheets, which includes a requirement to allow plant to be mathematically modelled with sufficient accuracy to permit the efficient procurement of SRAS and NSCAS
- specify the information, including the types of models, that generators, network service providers, network users, prospective SRAS providers and NSCAS tenderers must provide
- specify the model accuracy requirements that are applicable to each type of model provided to AEMO, as well as the types of generating systems and plant that the model accuracy requirements apply to
- specify when parties need to provide relevant information and the reasonable timeframes within which parties and AEMO must provide information to each other
- specify a process to be followed in circumstances where a person is unable to provide information that is otherwise required to be provided
- include 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
- specify the format that information needs to be provided in and whether AEMO will treat any of the information provided as confidential information under rule 8.6.

2.5 How the draft rule compares with the proposed rule

The draft rule largely reflects the intent of the proposed rule. However the draft rule contains some consequential amendments to the proposed rule to reflect the Commission's approach as described at the beginning of Chapter 3.

The draft rule allows for the provision of more detailed information by clarifying the responsibilities of parties in terms of their model information provision obligations through redevelopment of the model guidelines and data sheets. It imposes obligations on AEMO in terms of how it must develop its guidelines and data sheets, and requires

AEMO to set out the specific requirements about what type of model data must be provided and under what circumstances, in the guidelines and data sheets.

The Commission considers that while this approach will allow AEMO and where relevant, network service providers to obtain the model data necessary to undertake accurate power system studies, it also provides greater clarity in regards to the responsibilities of all parties. This is particularly the case in regards to requiring AEMO to clearly set out in the guidelines and data sheets what model data is to be provided, and the specific circumstances under which this will occur. The draft rule also introduces principles that AEMO must have regard to in developing the guidelines and data sheets, specifically that AEMO should seek to manage any cost impacts and protect confidential information of third parties.

This is in contrast to the proposed rule which, while specifying in the NER that an EMT-type model data would be required under specific circumstances, also provided AEMO discretion to request this EMT-type model data under a high level set of conditions.

The Commission considers that this approach would have both introduced unnecessary inflexibility into the model data provision framework (by specifying EMT-type models in the NER), while also creating significant market uncertainty as to when and what type of model data would be required by AEMO.

A more detailed explanation of the consequential amendments to the proposed rule are described in Appendix C. Chapter 3 sets out a more general description of the key policy positions that are expressed in the draft rule, including the Commission's reasoning for each policy position.

2.6 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 draft 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 draft rule provides clarity around the extent of these obligations. This will help participants to plan for and manage the extent of these costs.

The draft 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.

The draft rule establishes responsibilities for specified participants to provide model data in the NER, and then requires AEMO to establish a greater level of detail for these requirements in the guidelines and data sheets, subject to general principles in the NER.

This chapter summarises the key issues considered by the Commission in developing the draft 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 its 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
- the range of participants required to provide model data to AEMO and network service providers
- availability of more detailed model data to third parties.

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.[53]

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 inadequate as they do not fully cover new and emerging generation technologies.

AEMO added that inadequate power system studies of the power system results in inefficient methods to manage the uncertainty around the impact of new generation on network transfer capability. These inefficient methods may include overly conservative limit calculations or overinvestment in network plant.[54]

3.1.2 Stakeholder views

Many stakeholders agreed in their submissions that changing power system conditions are impacting on the ability of AEMO and other parties to undertake accurate modelling of the power system.[55]

Other stakeholders, including Vestas and Siemens Gamesa, 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)[56] and the need for AEMO to require additional model data from existing participants under certain circumstances.[57]

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

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

55 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.

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

57 Ibid., p. 10

Siemens Gamesa noted that in certain grid conditions, EMT-type models would be used.[58]

Ergon Energy and Energex provided evidence in their submission that reductions in system strength are likely to have an increasingly significant impact in some parts of the Queensland distribution network. Pointing to forecast generator connections across the distribution areas, Ergon and Energex highlighted that there is increasing evidence of low short circuit ratios, suggesting a general reduction in system strength. In these conditions, Ergon and Energex suggested that EMT models would be needed to deliver accurate power system studies.[59]

3.1.3 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).[60] This displacement of synchronous generation is projected to greatly reduce system strength across the NEM.[61]

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

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

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

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

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

the denominator of the fraction that represents the SCR, without contributing to the numerator.[62]

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.[63]

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[64] 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

62 Ibid. p.vi

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

64 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. .

EMT-type models to validate models and ensure key negative behaviours are caught and understood.[65]

Box 3.2 AECOM advice: the need for EMT models[66]

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 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

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

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

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.[67]

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 model data results in less accurate power system studies being 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 of 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.[68] They may be re-evaluated if there are alterations made to generating system equipment.[69]

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.[70] 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.

67 Ibid., pp. 14-15

68 See clause 5.3.4A of the NER.

69 See clause 5.3.9(c) of the NER.

70 See rules 5.7 and 5.8 of the NER.

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 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.[71]

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.[72]

3.2.2 Stakeholder views

Some stakeholders argued that there was no need to further increase AEMO's information gathering powers, or to increase model data provision obligations for

71 AEMO submission,12 April 2017, p. 4

72 Ibid.

participants. Participants also raised concerns regarding the discretion the proposed rule allowed AEMO in terms of requesting model data from participants.

Alinta Energy noted that while it "agrees that changing power system conditions are impacting on the ability of 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."[73]

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 that "the proposed rule changes are ambiguous, broad in scope and will potentially significantly increase compliance costs for market participants."[74]

A similar view was shared by ENGIE,[75] EnergyAustralia[76] Origin Energy,[77] and Vestas.[78] Basslink noted that while the risks of less accurate modelling are real, it also considered that AEMO's rule change addresses the problem in an "extremely inadequate way" in relation to existing participants.[79]

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 guidance, including criteria, should be provided to AEMO when seeking additional modelling data".[80] 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.[81]

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 any discretionary information requests.[82]

Siemens Gamesa did not agree with the general need for more detailed model data, and stated that AEMO needed to be more explicit about what it was studying and more adequately explain in what situations it would require an EMT type model.[83]

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

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

75 ENGIE submission, 12 April 2017, p. 2

76 EnergyAustralia submission, 12 April 2017, p. 1

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

78 Vestas submission, 12 April 2017, p.2

79 Basslink submission, 12 April 2017, p. 4

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

81 Ibid. p. 5

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

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

3.2.3 Assessment

AEMO's ability to obtain information

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

d) any other statutory function for which this Law authorises AEMO to gather information by means of a market information instrument.[84]

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 draft 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.

84 See section 53(2) of the NEL.

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 establish the 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 NER model data provision framework requires model data to be submitted to AEMO by generators as part of their connection process,[85] when generators propose an alteration to their generating systems,[86] and as part of the tender process for the provision of NSCAS and SRAS.[87]

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 proposed 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. This is discussed in further detail in section 3.4.

The Commission also acknowledges that the existing NER model data provision framework applies only to generators, and specifically, generating equipment. This is

85 See clause S5.2.4 of the NER.

86 See clause 5.3.9 of the NER.

87 See clause 3.11.5 and clause 3.11.9 of the NER.

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 explicitly 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, in accordance with the more specified requirements and circumstances set out in the guidelines and data sheets. 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.[88] 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 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 would be approximately $75,000.[89]

3.3.2 Stakeholder views

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 $500,000 per generating unit.[90]

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

89 AEMO submission,12 April 2017, p.8

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

EnergyAustralia noted, that while AEMO's estimated value of $75,000 for more detailed modelling may be appropriate for new generating systems, for existing plant it could be much higher, depending on the specific scope of the modelling sought by AEMO.[91]

Origin stated that 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".[92]

Siemens Gamesa estimated the costs of developing an EMT-type model in the vicinity of €12,000,000.[93]

Cost estimations submitted by stakeholders did not include a detailed explanation or justification for those estimates.

Ergon and Energex stated that the costs incurred while developing EMT-type models of equipment were a prudent investment and were recoverable.[94]

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) and that the NER should allow for the recovery of such costs.[95]

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.[96] 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.[97]

ENGIE 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.[98]

91 EnergyAustralia submission, 12 April 2017, p. 2

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

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

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

95 Ibid., p.7

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

97 Ibid., p. 12

98 ENGIE submission, 12 April 2017, p. 2

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.[99]

Hydro Tasmania noted that some existing generator upgrades, particularly control systems, often have a large portion of their costs attributed to modelling.[100] It further added that any further increase in costs could see these projects being unfeasible which would be a negative outcome for the power system as upgrades are often beneficial for power system security and performance.[101]

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.[102]

Alinta Energy added that apart from the significant cost to existing participants, AEMO's proposed solution would provide little additional benefit for those participants".[103]

3.3.3 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.

99 Basslink submission, 12 April 2017, p. 2

100 Hydro Tasmania submission, 13 April 2017, pp 1-2

101 Ibid p. 2

102 EnergyAustralia submission, 12 April 2017, p. 1

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

Box 3.3 AECOM advice: costs of EMT-type model development[104]

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 and 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.[105]

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	
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.

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

105 Ibid., p. 9

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,[106] 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.

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 draft 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 clarity in its guidelines and data sheets regarding the specific conditions under which model data will be provided.[107]

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106 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.

107 See clause S5.5.7 (b1) of the draft rule

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.[108] These aspects of the draft 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 draft rule. The Commission's reasoning is set out in further detail in section 3.4.

The draft rule also seeks 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 incurred for registered participants. The draft rule therefore requires AEMO to use reasonable endeavours to accept a range of software simulation products and versions.[109] This may help participants to manage costs by electing to use the software package of their choice.

The draft 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 draft rule therefore seeks to provide clarity regarding the timeframes associated with this process. The draft rule requires AEMO to establish in its guidelines and data sheets, the relevant timeframes within which parties and AEMO must provide information to each other.[110]

108 See clause S5.5.7(c)(1) of the draft rule.

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

110 See S5.5.7(b1)(4) of the draft rule.

The Commission also 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 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.

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 draft 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, large network users, ancillary service providers and generators with capacity less than 30MW. It does this by requiring these participants to provide the information in accordance with the requirements set out by AEMO in the guidelines and the data sheets.

The Commission considers that the specifics 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 draft 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.[111]

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.[112]

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 three 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
2. when alterations are proposed to a generating system, or to the protection systems of certain network users or network service providers
3. 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.

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:

- **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.[113]
- **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.[114]

111 See draft rule clause S5.5.7(b1)

112 See clause S5.5.7 of the NER.

113 Ibid. p. 5.

114 Ibid. p.5.

- **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.[115] AEMO was of the view that this could apply in a retrospective manner, based on circumstances in the power system.

3.4.2 Stakeholder views

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.[116]

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.[117]

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 clauses, which require additional data to be provided in specific conditions, to require provision of model data where AEMO considered this necessary.[118]

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115 Ibid. p. 13.

116 EnergyAustralia submission, 12 April 2017, p. 7

117 ENGIE submission, 12 April 2017, p. 2

118 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.

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.[119]

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.[120]

Existing plant

Most stakeholders were concerned about the cost implications associated with 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.[121]

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.[122]

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.[123]

Energy Networks Australia, Ergon and Energex supported the requirement that in some cases related to system strength or network stability, existing generators should provide additional and updated model data to AEMO and to network service providers.[124]

3.4.3 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.

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119 ENGIE submission, 12 April 2017, p. 2

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

121 Basslink submission, 12 April 2017, p. 3

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

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

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

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 draft 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 draft rule clarifies that generators will face an ongoing obligation to provide AEMO with updated model data, where requested to provide this by AEMO.[125]

The draft 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 or network user connections, proposed alterations to existing plant, when surrounding power system conditions have changed and the procurement of ancillary services.

The draft 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, certain network users, prospective NSCAS tenderers and prospective SRAS providers.[126]

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 draft 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 plant that the model accuracy requirements apply to.[127]

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

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125 See clause 5.2.5(b)(7) of the draft rule.

126 See clause S5.5.7(b1)(1) of the draft rule.

127 See clause S5.5.7(b1)(2) of the draft rule.

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 draft 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.[128]

Alteration of a generating unit

Alteration to a generator'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 draft rule therefore requires the guidelines to set out the types of models that AEMO may request from generators who are proposing to alter their generation systems.[129] 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 proposing the alteration, as well as the model accuracy requirements that are applicable to each type of model provided.[130]

Provision of model data by an existing generator

Finally, the Commission considers that existing generators 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 generator and AEMO requires updated model data from the generator to maintain the accuracy of its power system studies.

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.[131] However, for the avoidance of doubt, the draft rule introduces a new clause that specifies an obligation on generators to provide model data, where requested by AEMO. This is intended to clarify that existing generators may be required to provide

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128 See clause S5.5.7(b1)(6) of the draft rule.

129 See clause S5.5.7(b1)(1)(i) of the draft rule.

130 See clauses S5.5.7(b1)(2) and (6) of the draft rule.

131 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 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 draft rule is designed to apply more generally, including to existing connected generators that have completedthe connection process.

updated model data, even if they have not proposed an alteration to their generating system.[132]

However, the Commission recognises that requesting model data from an existing generator who is not proposing an alteration to its system could impose material costs on the generator. The draft 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 any request by AEMO to a generator for additional model data.[133]

Furthermore, the Commission also considers that the general obligations in the draft rule for AEMO to establish the conditions under which it will request additional model data will provide certainty and clarity to participants as to when AEMO may request model data from existing participants.[134]

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,[135] that would help achieve the same goal that a more detailed model could, but at a lower cost.

The draft 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.[136] The Commission expects that this process would largely reflect the existing "variation request" framework contained in the existing Generating System Model Guidelines.[137]

The framework allows generators or connection applicants to request a waiver from meeting some requirements set in the guidelines and data sheets, by stating reasons and providing proof 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

132 See clause 5.2.5(b)(7) of the draft rule.

133 See clause 5.2.5(b)(7) of the draft rule.

134 See clause S5.5.7(b1)(6) of the draft rule.

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

136 See clause S5.5.7(b1)(5) of the draft rule.

137 See section 5.1 of the Generating System Model Guidelines.

- request further information.

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.[138]

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 views

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.[139]

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

139 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.[140]

Basslink was concerned that if model data was to be provided by non-generating participants:[141]

- 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.[142]

3.5.3 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 and network users. The draft rule therefore brings these 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 draft rule therefore brings these participants more clearly into the NER model data provision framework.

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, network users and ancillary service providers.

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

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

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

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 required to submit less registered system planning data and less registered data than is indicated in the guidelines and data sheets.[143]

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 draft rule addresses 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[144]and play a major role in the negotiation of generator performance standards, their access to accurate model data is important.

Therefore, the draft rule explicitly brings smaller generators into the NER model data provision framework, but consistent with the approach in the draft rule for other types of participants, the guidelines and data sheets will specify what type of models should be provided to them and under what circumstances.[145]

Customers and network service providers

The Commission understands that certain equipment owned by network service providers and network users other than generators (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

143 See clause S5.5.6 of the NER.

144 See clause 4.14(o) of the NER.

145 See clause S5.5.6 and S5.5.7(b1)(1)(i).

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 and network users.

The Commission understands that there are costs associated with providing model data to AEMO by network service providers and network users. These costs are also relevant for smaller generators. 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).

Therefore, the guidelines and data sheets are required to clearly set out what type of models should be provided to AEMO and under what circumstances, as well as the model accuracy requirements that are applicable to each type of model.[146]

The draft rule also introduces 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. This threshold is consistent with AEMO's generator registration guidelines that allow generating systems with annual exports less than 20 GWh to apply for an exemption from registration as a generator.[147]

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 framework. The Commission considers that bringing these participants into the NER model data provision framework will 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 draft rule refers only to the provision of model data from ancillary service providers as part of the tender process to provide ancillary

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

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

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. 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.[148] This could include clauses for the provision of additional or updated model data, where required by AEMO.

The draft 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.[149]

3.6 The availability of information to third parties

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.[150] 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 draft rule, this model data that is passed on to third parties could include more detailed model data provided by participants under the draft 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 (OEMs) 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.

3.6.1 AEMO's view

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

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

149 See clauses 3.11.5(b)(5), 3.11.9(g) and S5.5.7(b1)(1) of the draft rule.

150 See clause 3.13.3 of the NER.

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.

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.[151]

3.6.2 Stakeholder views

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.[152]

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.[153]

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.[154]

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.[155]

DIgSILENT,[156] Ergon and Energex[157] 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.[158]

3.6.3 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

151 AEMO submission,12 April 2017, p. 6

152 Alinta submission, 12 April 2017, p. 3

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

154 Vestas submission, 12 April 2017, p. 3

155 Origin Energy submission, 2 April 2017, p. 5

156 DIgSILENT submission, 12 April 2017, p. 2

157 12 April 2017, p.5

158 Energy Networks Australia submission, 12 April 2017, pp 8-9

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 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.

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 OEM's may still have reservations about this more detailed model data being made available to third parties.

The draft 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 draft 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. The Commission considers that this approach will help assuage concerns of OEM's 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.

Under this framework, 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.[159] 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,

159 See clause 3.13(k)(3) of the NER.

- 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.[160]

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 3.3 AECOM advice: protection of model data[161]

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.[162]

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.[163]

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

160 8.6.1 (b) of the NER.

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

162 Ibid., p. 13

163 Ibid., p. 3

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 draft 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 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.

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.

The draft rule therefore introduces a requirement for AEMO to set out in the Power System Model Guidelines, Generating System Design Data Sheet, and Generating System Setting Data Sheet the circumstances in which AEMO will consider the information requested under clause 3.13.3(k) to be "reasonably required" by the registered participant.[164]

The draft 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.[165]

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.

164 See clause 3.13.3(k1) of the draft rule.

165 See clause S5.5.7(c)(3) of the draft rule.

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.

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 Power System Model Guidelines, Power System Design Data Sheet, and Power System Setting Data Sheet 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.

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

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 this document, 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.

B Legal requirements under the NEL

This appendix sets out the relevant legal requirements under the National Electricity Law (NEL) for the Commission to make this draft rule determination.

B.1 Draft rule determination

In accordance with section 99 of the NEL the Commission has made this draft rule determination in relation to the rule proposed by AEMO.

A copy of the draft rule is attached to and published with this draft rule determination. Its key features are described in section 2.4.

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

B.2 Power to make the rule

The Commission is satisfied that the draft rule falls within the subject matter about which the Commission may make rules. The draft 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 draft 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.[166] Under those regulations, only certain parts of the NER have been adopted in the Northern Territory.[167]

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.

166 Refer to National Electricity (Northern Territory) (National Uniform Legislation) (Modification) Regulations.

167 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 draft rule either:

- have no application in the Northern Territory because they relate to provisions of the National Electricity Rules that have no effect 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 round consultation;
- 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.[168]

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.[169] The draft rule is compatible with AEMO's declared network functions because it enhances the proper performance of those functions.

B.5 Civil penalties

The draft rule does not amend any clauses that are currently classified as civil penalty provisions under the NEL or National Electricity (South Australia) Regulations. The Commission does not propose to recommend to the COAG Energy Council that any of the proposed amendments made by the draft rule be classified as civil penalty provisions.

168 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.

169 Section 91(8) of the NEL.

C How the draft rule compares with the proposed rule

The draft rule reflects the intent of the proposed rule. However some consequential amendments have been made to the proposed rule to reflect the Commission's approach. A summary of these amendments is set out below.

Clause 3.11.5 and clause 3.11.9

These clauses are largely the same except that the draft rule uses new term Power System Model Guidelines, Power System Design Data Sheet, and Power System Setting Data Sheet and makes clear that provision of NSCAS and SRAS tender information is done in accordance with the requirements specified in the Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet.

Clause 3.13.3

- There was no amendment proposed by AEMO in relation to the standing data framework in existing clause 3.13.3, but the draft rule inserts a new paragraph (k1) that requires AEMO to set out in the Power System Model Guidelines the circumstances in which it will consider the information under clause 3.13.3(k)(2) to be reasonably required by a registered participant.
- The purpose of this is to provide clarity to registered participants, as the Commission expects that AEMO will use this provision to differentiate (in the Power System Model Guidelines) between those circumstances in which it considers more or less detailed models are reasonably required by registered participants. For example, the different circumstances in which new connecting generators may require RMS or EMT type models.

Clause 4.14.4(j)

- AEMO's proposed drafting used a cross-reference to another new proposed clause, being S5.3.1(a1), to describe the kind of information that each network service provider must provide to AEMO. Instead, the draft rule sets out the information required to be provided in full so that it is clear what the network service provider may be required to provide in these circumstances.
- Consistent with the approach taken in other parts of the draft rule, this new paragraph also makes clear that provision of such information must be done in accordance with the requirements specified in the Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet.
- In addition, the draft rule has also adopted the broader concept of "power system simulation studies" rather than "load flow and dynamic simulation studies" to capture a broader scope of simulation studies. The Commission understands that the phrase "load flow and dynamic simulation" may capture a subset of power system simulation studies that AEMO and network service providers need to carry out for the management of power system security, procurement of ancillary services, and to ensure that all power system components are protected from damage. In its rule change request, AEMO advised that the studies it now needs to undertake include load flow, fault level, dynamics, harmonics, and several

types of specialised power system studies, which may not have been captured by the phrase "load flow and dynamic simulation".

- The draft rule also makes it clear that AEMO must nominate its preferred software products in the Power System Model Guidelines. By specifying this information in the guidelines, this information is known by participants and is subject to consultation with interested parties during the development of the revised guidelines.

Clause 5.2.5

- There was no amendment proposed by AEMO in relation to this clause. The draft rule introduces a new paragraph (7) in clause 5.2.5 to make it clear that AEMO is able to obtain new or updated modelling information from existing generators in circumstances where there is no alteration to the generator's plant, but there is a change in the power system conditions surrounding that generator, such that AEMO requires new or updated information from that generator.

Clause 5.3.9

- In the proposed rule, some of the existing wording in this clause was deleted and was replaced with wording to provide AEMO with a certain amount of discretion to determine whether the generator's proposed alteration would have an adverse effect on the power system. In the draft rule, the wording of the existing provision has been retained and the wording from the proposed rule has largely been retained as well
- Therefore, this has the effect that clause 5.3.9 applies in two situations:
  - where a generator considers there is an alteration to its plant that will affect the performance of its generating system relative to the technical requirements in the specified clauses
  - where in AEMO's reasonable opinion, the alteration 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 another network user.
- Consistent with the approach taken in other parts of the draft rule, AEMO is required to set out the more detailed information requirements in the Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet.

Clause S5.2.4

The proposed rule inserted a new paragraph (5A) in this clause which specifically mentioned electromagnetic transient simulation analysis. This has not been included in the draft rule, consistent with the Commission's view that the Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet, rather than the NER, is the appropriate place to set out this level of detail. Instead, the draft rule expands the existing paragraph (5) to refer to the broader concept of "power system simulation studies" rather than "load flow and dynamic simulation" to include these other more detailed types of models in the existing provisions. As such, the Commission expects that the kind of information set out in paragraph (5A) of the

proposed rule would instead be set out in the revised Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet.

Clause S5.3.1(a1)

The proposed rule included a new paragraph (a1) in this clause, which the draft rule has largely retained, but with two new subparagraphs added. The draft rule has included a requirement for provision of the model source code. The Commission understands that model source codes is required for AEMO to be able to independently manage and maintain the overall NEM power system model, and to be able to migrate to any future versions of the relevant simulation tool. Without the source code, AEMO would be unable to manage the overall power system model which it is required to maintain and disseminate to all registered participants. However, the Commission also understands that model source code would likely never be provided for an EMT type model. As such, the words "where applicable" have been included to account for the circumstances in which EMT models may be provided.

Clause S5.5.6

The draft rule simplifies this clause to state that a generator who connects a generating unit less than 30 MW (or a number of generating units totalling less than 30 MW) must submit data in accordance with the data sheets and Power System Model Guidelines. While it may remain the case that these types of generators are usually required to submit less registered system planning data and less registered data, the Commission expects these variances to be set out in the data sheets and Power System Model Guidelines.

Clause S5.5.7

- The draft rule makes a number of amendments to clause S5.5.7, including changes in addition to those set out in the proposed rule
- Paragraph (a) largely remains the same as the proposed rule, with the exception of required changes to include the additional cross-references for the new clauses that contain obligations relating to the provision of information in accordance with the data sheets and Power System Model Guidelines.
- The draft rule amends paragraph (b) to include an additional limb relating to the purpose of accurate modelling, being for the efficient procurement of SRAS and NSCAS.
- The draft rule introduces a new paragraph (b1), which summarises the clauses in the NER that have obligations to provide modelling information and sets out the minimum requirements that must be included when AEMO is developing and amending the Power System Model Guidelines, Power System Design Data Sheet and Power System Setting Data Sheet. Although this clause was not in the proposed rule, the information is drawn from the issues raised in AEMO's rule change request and content in the existing Generating System Model Guidelines and data sheets.
- The draft rule has a different paragraph (c), which introduces principles that AEMO must have regard to when developing and amending the data sheets and

Power System Model Guidelines. These principles address some of the concerns raised by stakeholders in submissions to the consultation paper.

- The draft rule retains the framework in the current NER for amending the Power System Model Guidelines and data sheets in existing paragraphs (c), (d) and (e), but the draft rule clarifies this framework in the new paragraphs (d) – (h).

Further detail on the reasoning behind the draft rule can be found in Chapter 3.