Generating System Model Guidelines Rule change proposal

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Energy Networks Australia

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Executive Summary

Energy Networks Australia generally supports the objectives of the Rule change proposal to enable the provision of detailed model data to support more effective power system studies by the Australian Energy Market Operator (AEMO) and Network Service Providers (NSPs).

This is expected to yield benefits for electricity transmission and distribution planning processes as well as the operation of the power system more generally.

However, Energy Networks Australia has identified a number of issues, which require further consideration and/or clarification prior to development of the Draft Determination and Rule. Our key concerns are that:

- the Rules should provide sufficient guidance to AEMO on the nature and detail of information that can be requested from market participants, including to additional AEMO requests;
- the Rules must ensure that NSPs can recover the costs associated with any additional requirements;
- considers that NSPs should also be permitted to request this additional modelling data to execute their planning obligations;
- there are a number of compliance-related issues that need to be considered; and
- appropriate arrangements be put in place to enable data to be shared with market participants.

We have also taken the opportunity to provide additional commentary on generator obligations for the provision of electromagnetic transient models (EMT) and additional distribution related matters.

1. General support for rule change proposal

Energy Networks Australia supports the objectives of the Rule change proposal to enable the provision of more detailed model data to support more effective power system studies by AEMO and NSPs. The benefits of the proposal will also include:

- helping to identify network limitations earlier than current modelling practices may otherwise allow.
- improving stakeholder knowledge of actual generator performance and compliance against technical standards under specific operating conditions (which can then be better represented during the formulation of network constraints, for example).
- assisting AEMO to undertake a more robust System Restart Ancillary Services procurement process, e.g. as part of the development of AEMO's National Transmission Network Development Plan (NTNDP). This can also extend to tender processes for Network Support and Control Ancillary Services (NSCAS), and some Frequency Control Ancillary Services (FCAS).
- further clarifying the existing Rules' arrangements as to the level of detail of model data required from generators. While the Rules are explicit that Generators' with a combined nameplate rating of 30 MW or more must provide AEMO and the relevant NSP information about the controls of their *generating systems* to allow those parties to perform load flow and dynamic simulation studies, the Rules do not specify the type of model data that is required to be provided.
- assisting intending participants to plan investments and more effectively negotiate access standards.
- better informing NSP investment decisions and enabling more timely and effective NSP assessments of the impacts of new (and existing) Generators on intra- and inter-regional network transfer limits as well as the impacts on other network participants. This could result in further opportunities to avoid building additional network capacity.
- allowing AEMO and TNSPs to perform the necessary modelling to understand the minimum system strength issues and TNSP/generator obligations proposed in the AEMC's System Security Frameworks Review Directions Paper.

Benefits related to network services

From an NSP perspective, access to more detailed modelling and data could provide a number of additional benefits, which would ultimately result in more efficient outcomes for consumers. These are discussed further below.

i) Assessments

In terms of power system assessments, such information would allow NSPs to undertake improved power system security assessments, which in turn can be used to identify the volume and type of ancillary services necessary to secure operation of the power system under various operating scenarios. For example, to more accurately assess the minimum required system strength to

ensure the stable operation of inverter-based generation facilities. NSPs would also be able to conduct maximum power transfer capability assessments with a higher degree of confidence due to the improved quality of simulation outcomes, especially for onerous system conditions.

In the current and expected future environment of significant change in the national energy and electricity markets, the provision of electromagnetic transient models (EMT) for existing plant can lead to broader improvements in the overall modelling of the National Electricity Market (NEM), rather than just plant and equipment installed by new entrants.

ii) More efficient connection process

Currently AEMO and a number of NSPs face challenges in obtaining certain models and data from connection proponents (including project developers and equipment manufacturers) on the basis that the information is detailed, proprietary and commercially sensitive. NSPs and AEMO (based on our interactions with AEMO on such matters) consider that such information will clearly facilitate more robust analysis and assessments in relation to potential connections.

In our experience, 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. Energy Networks Australia also considers that these requirements are likely to minimise any future impact on the eventual plant owner who may not have the same degree of access to, or commercial leverage with, the original equipment manufacturer as would the initial project developer.

iii) Coordination and Compliance

The ability to access more detailed information could lead to better coordination, collaboration and problem solving opportunities between NSPs, generators and AEMO. Energy Networks Australia considers that the provision of more detailed and sophisticated information would also better enable NSPs to meet their Rules compliance obligations and to assess the compliance of generators who seek to connect to their networks.

2. Guidance to AEMO

The Consultation Paper highlights at page 11:

> "Under AEMO's rule change request, existing Generators, TNSPs or other registered participants, would be exempt from having to provide additional modelling 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*".

Energy Networks Australia appreciates that this would likely mean that AEMO would have discretion to require additional information, potentially including both a broader scope and more detailed modelling information, from existing registered participants, including Generators and NSPs.

Energy Networks Australia suggests that appropriate guidance, including reasonable criteria, should be provided to AEMO when seeking such additional modelling data. 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.

Potential avenues through which these criteria can be established include the Transmission Consultation Procedures established in the Rules or via the Plant Modelling Reference Group (PMRG) convened by AEMO. Distribution businesses should also be represented given that these issues may also impact them.

3. Information needs of NSPs

Energy Networks Australia considers that NSPs should also be permitted to request this additional modelling data to execute their planning obligations. For example, NSPs may identify a need for this detailed modelling data in advance of AEMO's needs including under their power system security obligations; where NSPs are evaluating future network reinvestment or possible network consolidation options that have an impact on system strength.

Energy Networks Australia recognises this should be subject to the equivalent guidance to that proposed for AEMO in section 2.

Energy Networks Australia agrees that the AEMC will need to further investigate and clarify whether this prospective expanded range of discretionary information requests can be requested under existing powers or mechanisms available to AEMO under the National Electricity Law or Rules.

4. Costs for Network Service Providers

The AEMC recognised that NSPs and generators may face additional compliance costs if they are required to provide more detailed model data to AEMO. The AEMC also acknowledged that the cost impacts may vary depending on the stage at which the model/data is requested in the connection process (i.e. up-front versus applications already in train or completed) and asked whether the requirements should be different for new entrant and incumbent generators (pp. 19-20).

Overall, Energy Networks Australia member experience indicates that the costs that could potentially be incurred by NSPs may vary on a case-by-case basis, depending on the individual circumstances, some of which are discussed below.

- If the EMT model already exists and only needs to be 'repackaged' to make it fit-for-purpose, then this should be possible at minimal cost. However, if the model does not exist, then the costs for NSPs will reflect how complicated the model is to prepare.
- 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). Modelling of some protection devices could also be non-trivial. More complex models would likely require OEM assistance and would therefore involve more material cost than if the model were already available in the appropriate level of detail and formats.
- Providing EMT data for transmission lines and other types of more standard substation equipment will still take time to compile. It follows that the preparation of even 'simple' data sets will still have some cost implications associated with them.

Aside from the direct costs associated with procuring the EMT models and data, Energy Networks Australia considers that the potential requirements advanced in the Consultation Paper represent a significant step-change in the volume of modelling data that will need to be managed on an on-going basis. The costs associated with establishing and maintaining larger, more complicated and reasonably up-to-date data sets is likely to be material. The Rules must ensure that NSPs can recover the costs associated with meeting any additional requirements.

Cost recovery options

Energy Networks Australia considers that two potential cost recovery mechanisms may be appropriate, particularly where the Revenue Proposal of the NSP did not account for such costs. The two options include either:

- robust and non-detrimental transitional and savings arrangements under the Rules; or alternatively,
- the cost pass through provisions provided for under the Rules.

Compliance related considerations for Network Service Providers

The AEMC's paper notes that AEMO's Rule change request seeks to broaden the scope of its information gathering to require NSPs to provide model data of equipment such as transformers, SVCs and synchronous condensers (as well as for generators to provide additional model data of equipment such as governors and protection systems), as well as requiring the provision of more detailed EMT-type models in certain situations.

Some of the important compliance issues facing NSPs in relation to developing and maintaining models of their own assets include:

- Validation of models of network based assets, presumably in a similar manner as applied to a generating system, e.g. preparation and submission of R1 (detailed design) and R2 (post-commissioning) models. The veracity of EMT-type models can potentially be managed through a combination of certification and onsite validation tests/measurements.
- Periodic validation of models to ensure continued compliance with accuracy requirements is also envisaged.
- Database administration and management requirements, including appropriate auditing processes, will likely need to be considered.
- Ongoing information provision to AEMO, including the timing and format of information to be exchanged.

Energy Networks Australia has identified these items to inform the AEMC's considerations on the potential practical impacts of AEMO's proposal as well as the materiality of additional costs that may be incurred.

5. Sharing of information

A key issue flagged by the AEMC is which parties should have access to EMT-type model data and, if so, in what form should that data be provided. This issue is somewhat multi-faceted, and includes technical and commercial/legal considerations.

Technical benefits

Energy Networks Australia considers that:

- EMT-type models can be encrypted and should be made available in a format that enables them to be shared between NSPs, AEMO and relevant market participants, which may include intending market participants that have lodged a connection application.
- Sharing of model data should also extend to EMT-type models of NSP plant such as SVCs and STATCOMs.
- EMT-type models should be shared in the same way that existing PSS/E models are shared between NSPs and AEMO to facilitate network planning and connection studies.
- It should also be possible to share the same model data with registered and relevant market participants to enable such parties to carry out suitable analysis for the purposes of developing controller and protection settings for their own plant and equipment (where detailed models are required to do so).

Commercial and legal issues

It is suggested that the AEMC give careful consideration to the following issues:

- Without an ability to share EMT-type models with relevant market participants, NSPs may be unintentionally assigned the role of default designer for the controller and protection settings of connecting plant. The scope of the NSP's obligations would therefore extend beyond the current 'review role'. This creates a potential commercial risk issue in relation to legal liabilities and the coverage of existing business insurance policies for NSPs. Given the potential materiality of this matter on NSPs as well as other stakeholders, Energy Networks Australia encourages the AEMC to give this matter explicit consideration, including whether the AEMC considers such a role could also be provided on a non-regulated basis.
- If only encrypted models are available to NSPs, controller block diagrams should also be made available to adequately explain the operation of the models in question. Such an approach can also help guard the Intellectual Property (IP) embedded in the more detailed type models.
- Proponents must also provide evidence of the veracity of this EMT-type model. This includes certification that the EMT-type model represents fully detailed inner control loops, phase locked loop (PLL), fault ride-through controllers, external voltage controllers, plant level controllers and all protection systems. It is also recommended that the EMT-type models embed the actual hardware code where possible. Verification should also include measurement results from an equivalent site and plant, lab tests and/or Hardware In the Loop (HIL) tests.
- The sharing of detailed models provided by NSPs (such as their SVC models) may require manufacturers' permission to share with third parties (e.g. other NSPs and registered participants). The same issue should be considered for generator models as well, particularly if the AEMC considers broad sharing arrangements should be put in place.
- Generation (wind and solar) is now predominately managed and controlled by in-house developed logic and as a result is usually not disclosed in detail to protect their IP. Firmware updates are common and difficult to manage, therefore consideration should be given to disallowing any Firmware upgrades without a re-submission of the Generator performance compliance and associated studies.
- Potential generators' may need to familiarise themselves with the sharing of confidential information (in relation to data and power system models). As a result, consideration should be given to this issue in regards to the framework necessary to allow detailed modelling information to be more widely shared.
- NSPs should not inadvertently be burdened with the role of default designer for potential generators unless the function is commercially negotiated and agreed to by both parties. The Rule change should avoid an outcome where NSPs have to undertake studies and analyses that have traditionally been performed by intending participants, new generators and their advisers/consultants, for subsequent review by NSPs.

6. Generator obligations for the provision of EMT models

Energy Networks Australia notes that AEMO's Rule change proposes that generators operating power electronically interfaced *generating systems* should be required to provide detailed EMT-type models in the following circumstances:

1. The interface is at the *transmission system* level; or
2. A *generating system* is connected at a distribution system level and the installed capacity of the plant is greater than 10% of the available fault level at the point of connection; or
3. 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.

We support the intent of having Generators respond in such circumstances. Given this, we note that information provided under current Rules requirements by some generators (and their manufacturers) to NSPs has been somewhat problematic.

New Generators

Energy Networks Australia supports AEMO's proposal that all ***new*** inverter-based generators connected to the *transmission system* deliver an EMT-type model to both AEMO and relevant NSP's regardless of the system strength at the time of the connection application. Energy Networks Australia considers that such an approach:

- is reasonable for all large scale inverter-based generators;
- would not materially increase costs to potential connection proponents using commercially mature technologies;
- would minimise legacy issues and likely delays in assessing connection proposals;
- clearly places the obligation on the initial proponent/developer to provide the model and not encumber a potential subsequent owner to provide and pay for this type of modelling data at a later date (and probably at a more significant cost).

Existing Generators

As discussed in Section 2 above, Energy Networks Australia notes that the rule change proposal includes the appropriate ability of AEMO to acquire additional modelling information for existing plant, where *"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".*

It is therefore necessary to consider when the obligation would commence and potential transitional provisions.

Our members continue to be concerned about legacy issues and being unable to appropriately model the power system and the interaction of existing and potential generators. Energy Networks Australia considers that this Rule may be a first step at improving information flow from generators and should assist in assessing the respective impacts on the overall power system. Energy Networks Australia supports the need for this Rule change to be practical and workable for both new and existing generators, as well as AEMO and NSPs.

We understand that it is highly uncommon, if at all, for Rules to be made with any retrospective effect. Ideally, NSPs would prefer that such models be made available as soon as possible. However, being mindful of some of the practical challenges in securing such information, the AEMC could consider a transitional six to twelve month period after the final Rule and determination is published, by which existing generators are required to meet the new obligations (limited by the proposed guidance discussed in Section 2) to release modelling data to AEMO and relevant NSP(s) if requested to do so.

In the interim, a potential way forward is for NSPs and AEMO to more closely liaise during the connections process, especially for connection points deemed to be technically problematic. This may help mitigate possible blind-spots that may be developing in the NEM. This may require a focus on South Australia, Victoria and parts of Queensland for TNSPs, and Queensland for DNSPs.

7. Additional considerations

Electricity distribution network issues

Energy Networks Australia has identified a number of issues arising in the distribution sector. A number of our members note that there are evolving network issues, which extend beyond the connection point of any given generator e.g. how multiple connected generating systems in a given area of the network, may interact with each other as well as the wider power system more generally.

Whilst the AEMC correctly notes the 30 MW threshold in the Rules for provision of certain generator modelling data, there is a need to consider the growing impact of multiple, smaller capacity generators connecting to the distribution network, which in aggregate, clearly exceed the 30 MW threshold. There are also emerging issues with inverter-based generation with capacity less than 30MW connecting to weak parts of the DNSPs network. Provision for models and validation of such models through tests for plant less than 30MW is anticipated in the AEMO's "Data and Model Requirements for Generating Systems of Less than 30MW" guidelines (section 4.4.2 and 5.0).

AEMO's rule change proposes that if a generating system is connected at a distribution system level and the installed capacity of the plant is greater than 10% of the available fault level at the point of connection, then an EMT-type model is required. If this is reflected in the Final rule and Determination, it would partly address some of the key DNSP concerns and bring certainty to the provision of these models

in excess of what is currently just an AEMO guideline.

Some additional clarity would be helpful on the *co-ordination* of modelling, including for a situation in an electricity distribution network when the aggregation of a fleet of small generation at a zone substation could appear as a very large generator to the system (greater than 30 MW) and in respect of the NSPs and AEMO's power system considerations.

Early recognition and management of complex dynamics occurring in distribution networks is equally important as in transmission systems. In the future, this will be necessary to manage the 'integrated network' where the distribution system requirements increasingly take on more of the challenges and considerations of transmission systems today.

We also understand that at a distribution level, there is a need to consider an appropriate capacity threshold below which the provision of detailed data is not practical. This is in recognition of the fact that proponents/manufacturers may be less mature in their technical offerings and more protective of their IP. It is recognised that if the threshold were set at a disproportionately low level, the provision of detailed models and associated data sets would become a material issue, introducing significantly greater costs that may not be justifiable.

Energy Networks Australia would like to acknowledge that the appropriate threshold level for *distribution networks* is a matter being further considered by some members.

Attachment 1 - Responses to Selected Consultation Questions

Issue 1 - Materiality of the issue

1. Are changing power system conditions impacting on the ability of AEMO, and other parties, to accurately model the power system?

Energy Networks Australia agrees with AEMO's concerns. Changing system conditions, in particular high penetrations of inverter based generation technologies, are introducing additional power system issues that need to be analysed using more detailed EMT-type models to help ensure system security. This is particularly the case for parts of the NEM where system strength is reducing (due to a lack of synchronous machine support) or a significant concentration of inverter-based connected generation exists. Both cases increase the need to examine the interactions of inverter-based connected generators with each other, as well as the surrounding power system more generally.

2. Given any such impacts, do existing NER requirements for the provision of model data remain sufficient for parties to undertake effective power system studies?

As a minimum, there appears to be an urgent need to address what modelling data (and model types) are explicitly required from Generators. Improvements to the Rules are required to enable AEMO and NSPs to undertake effective and efficient analysis of the power system which will include an increasing volume of inverter-based generation technologies.

Energy Networks Australia considers that NSPs should also be permitted to request this additional modelling data to execute their planning obligations. For example, NSPs may identify a need for this detailed modelling data in advance of AEMO's needs including under their power system security obligations; where NSPs are evaluating future network reinvestment or possible network consolidation options that have an impact on system strength.

3. Is it necessary to amend the NER to place more explicitly defined obligations on participants to provide specific modelling data to AEMO?

The intent of the proposed Rule changes documented by AEMO are considered appropriate subject to the additional discussions presented in this submission.

Issue 2 – Information gathering

5. Is the solution proposed appropriate?

The direction and intent of the Rule change is generally supported. However, there should not be outcomes where AEMO has unrestricted discretion to request data and modelling information.

Energy Networks Australia suggests that appropriate guidance, including reasonable criteria, should be provided to AEMO when seeking such additional modelling data. 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.

Potential avenues through which these criteria can be established include the Transmission Consultation Procedures established in the Rules or via the Plant Modelling Reference Group (PMRG) convened by AEMO. Distribution businesses should also be represented given that these issues may also impact them.

Issue 3 - Costs of compliance

6. What are the likely costs for participants of providing a broader scope of modelling data, or more detailed EMT-type models, to AEMO?

The likely cost related issues for NSPs is covered in Section 4 above (*Costs to Network Service Providers*).

8. What data provision requirements should apply to a generator that is halfway through the connection process, when new data provision requirements are introduced?

In the interests of minimising an accumulating legacy issue, it is proposed that generators half-way through the connection process be offered the choice of complying with the new requirements either

(i) as part of finalising the connection agreement, or

(ii) providing the additional data at a specified future date consistent with the options discussed for existing Generators as presented in the main body of this submission.

By opting to comply earlier, a generator who has not yet commissioned the proposed plant will have an opportunity to appropriately validate the additional model data during on-site testing activities, which are typically carried out either as part of, or immediately following, the commissioning program.

Issue 4 - Possibility of compliance

10. Are there any restrictions associated with providing data of the type contemplated in the rule change request?

Energy Networks Australia acknowledges the concerns of the AEMC. However, it is considered prudent to seek such information as the preferred default position and look to (potentially) offer a derogation or waiver of some description, if it can be evidenced that provision of the data is either not technically possible or that the costs of doing so are commercially prohibitive.

As power system security and reliability is in the long terms interests of electricity consumers, efforts should be made to minimise legacy issues where it is practical and cost effective to do so.

Issue 5 - Existing generators

11. Should AEMO be able to request additional modelling data from existing generators who are already registered and have executed connection agreements?

Yes. As discussed in Section 2, Energy Networks Australia notes that the rule change proposal includes the appropriate ability of AEMO to acquire additional modelling information for existing plant, where *"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".*

It is therefore necessary to consider when the obligation would commence and potential transitional provisions. Being mindful of some of the practical challenges in securing such information, the AEMC could consider a transitional six to twelve month period after the final Rule and determination is published, by which existing generators are required to meet the new obligations (limited by the proposed guidance discussed in Section 2) to release modelling data to AEMO and relevant NSP(s) if requested to do so.

12. Does the rule change request and the proposed rule provide sufficient guidance or clarity regarding what circumstances AEMO may require additional model data from existing participants?

Not yet. Energy Networks Australia recommends this be further clarified in guidance which is clear, and ensures that the information is collected on a basis that is consistent, predictable and proportionate given AEMO's requirement.

Issue 6 - Data disclosure

13. Should third parties have access to EMT-type models?

In general, yes. This issue is addressed in Section 5 (Sharing of Information) of the submission.

14. *What information should be made available to third parties? Would encryption of this data provide sufficient protection to address issues related to commercial sensitivity of the data?*

In general, yes, data encryption is considered appropriate for the protection of commercially sensitive data. This issue is addressed in Section 5 (Sharing of Information) of the submission.

15. Should EMT-type model data be provided only to AEMO, or should NSPs also have access?

NSPs should have access to EMT-type models provided by Generators as well as other NSPs. Where EMT models are encrypted for NSP and third party use, it would be expected that sufficient modelling documentation (including appropriate descriptions of the controller block diagrams) be provided to enable the models to be integrated

into simulation software and the model input/outputs to be correctly interpreted when analysing simulation results.

Proponents must also provide evidence of the veracity of this EMT-type model as discussed in Section 5 (Sharing of Information) of the submission.

16. Should information provided by NSPs be made available to third parties?

Yes. This issue is addressed in Section 5 (Sharing of Information) of the submission.