11 April 2017

Mr John Pierce
Chairman
Australian Energy Market Commission
PO Box A2449 Sydney South
NSW 1235

Dear Sir,

Comments to proposed rule change in relation to: Generator System Model Guidelines

Thank you for the opportunity presented to DIgSILENT Pacific (hereafter referred to as "DIgSILENT") to comment to the proposed rule change your reference ERC0219.

DIgSILENT is very encouraged by the AEMO initiative and awareness of the importance of accurate power system models for the purpose of simulation. DIgSILENT would in particular like to consider to the issues raised by AEMO and the AEMC and comment on the cost as well as availability of models for power system simulations and studies.

History

During 2008 NEMMCO made a rule change request related to the current request. In our submission in response to that earlier rule change DIgSILENT recommended that models be maintained "in a form that can be interpreted by at least three different software simulation products approved by NEMMCO". In its ruling, the AEMC commented that it considered "the availability of more than one software format promotes the NEO". For clarity it has to be stated that at the time these different software formats did not refer to software for different applications or functionalities, but for the same type of simulations.

Since 2008, some NEM TNSP's as well as DNSP's adapted different software platforms to what is commonly used by AEMO. Hence, the need for maintaining these different models has increased in our opinion, and though the AEMC does not ask any comments in this regard, DIgSILENT therefore again recommends that serious consideration be given to maintaining NEM models in more than one platform.

In the past, in the interest of fair competition and promotion of greater flexibility for participants undertaking power system studies, NEMMCO permitted alternative software models to be submitted. Though NEMMCO only maintained a model in a single software platform for steady state and RMS simulations, the conversion of models to that format was undertaken by NEMMCO.

Improved model accuracy

The benefits of the assessment of a plant or a region using more accurate models is not questioned and strongly supported. Historically a simple approach using a positive sequence network model only, might have been adequate for transient simulations of conventional synchronous machines. The argument was that the worst case fault was a three-phase fault and for that a positive sequence equivalent model would be adequate. Since the introduction of renewable generation, that argument is no longer valid as the worst case faults for inverter connected devices is typically an unbalance fault. A cost-effective solution to address the issue for unbalance fault simulation is the use of true 3-phase simulation software for steady state (load flow and short circuit simulations) and RMS simulations.

Another important factor to consider is the change in the NEM dynamic load behaviour. Currently the emphasis appears to be on generator data and accurate generator models. However the domestic and commercial load is perhaps changing faster with the introduction of rooftop PV and other embedded generation. With battery storage and more electric vehicle charging options in future, this change is likely to continue. The question is therefore, does an accurate generator model in isolation achieve the desired objectives when conducting grid impact studies? Is there an optimum middle ground? As the scope of the

simulations and use of the information is not known, it is not possible to definitively and confidently answer these questions.

Need for a rule change

The issue can be summarised as a request for additional model data so that a network model can be maintained in RMS and EMT environments rather than RMS alone. An important factor is the proposed application of the additional data. EMT study is an area of power system study which looks into plant interaction in sub-transient time frame (typical simulation time step of the order of 1 µs). Due to its high computational cost and sensitivities to model parameters, it is typically used for localized power system studies such as insulation coordination, equipment switching and sub-synchronous resonance. It would not be very cost effective for general purpose dynamic simulation involving the complete NEM power system in the EMT environment. The reasons for this are:

1. For a large power system, a single simulation of a few seconds in real time, may take several hours up to a day or more to complete. Furthermore, for each of these simulations, model parameter sensitivity analysis would be required. For instance the simulation response of a generator would be quite different depending on the operation of a single protection device (such as crow-bar operation in a wind turbine) in a generating unit. A small difference in the initial conditions or transient response may therefore have a significant impact on the outcome of the simulation. The only way to assess this is to conduct many simulations.
2. A complete NEM-wide system EMT model would be less stable and more likely to cause non-convergence of simulations. Non-convergence may occur at a remote part of the network that is not directly observed, but that may still impact on the accuracy of results.
3. For system impact studies, in particular when considering future scenarios, no data of future network enhancements (such as new renewable technologies) would be available. In this case, generic models would have to be used. The accuracy of generic models may not be enough to justify conducting simulations in an EMT environment.

Conducting local EMT simulations within an RMS NEM-wide simulation is the obvious solution. Again, it would be beneficial if the NEM RMS model was a true three-phase model with the ability to accurately simulate unbalance faults – something that renewables are particularly sensitive to.

Cost-benefit of proposed rule change

From a market point of view, the most cost effective solution would be to allow market participants the freedom to use the software of personal choice. Cost reductions are achieved through working with a familiar product; cost competition in an open market place; as well as access to the market by more participants. In our view therefore, the ideal solution would be if the complete NEM model is available to the market in multiple formats – not just the format of a single software vendor as is currently the case.

Europe is experiencing perhaps the most dramatic impact of renewable generation on its grid. Importantly it also operates a 50Hz network. In Europe, models are routinely used and provided in software formats different from what is used by AEMO. If AEMO had facilities to utilise these models that are type tested to strict European standards, significant savings could be realised.

The internationally accepted synchronous generator models provide proven accuracy for all stator quantities. Manufacturers provide data based on internationally accepted factory tests that are compatible with the standard model. One (minor) shortcoming if the model is its inability to precisely represent rotor current transients. In its submission AEMO has placed high accuracy requirements in rotor current that will require, at best, modification of the standard model and, at worst, development of a more complex model. This would have significant implications for the industry as additional testing will be required to determine the parameters of the enhanced model and the compatibility of manufacturer test data will be lost. The cost-benefit of this change should be assessed as the industry generally has not seen the need to address this minor issue with the standard model.

Model data availability to third parties

An important issue to consider is whether requested information should be made available to third parties. It would be highly beneficial if the model data would be available in a format that could be shared with grid participants. A shared model would not only support initiatives through R&D programs, but would also lead to more transparency to the market.

Specific questions asked

An attempt is made to answer or comment to some of the questions raised by the AEMC.

Q1: Given any such impacts, do existing NER requirements for the provision of model data remain sufficient for parties to undertake effective power system studies?

A1: Section 5.4.3, 5.4.4 and S5.5.2 of the NER have already given sufficient rights to the Network Service Provider for the provision of additional and sufficient model data.

Q2: Is it necessary to amend the NER to place more explicitly defined obligations on participants to provide specific modelling data to AEMO?

A2: Appendix A of AEMO's Rules Change Request has listed out six projects that required EMT studies that were completed prior to this Rules Change Request. This demonstrated AEMO, under its existing NEM roles, has the capability of obtaining EMT information and the market participants have also cooperated with AEMO when asked to do so.

Q3: What are the likely costs for participants of providing a broader scope of modelling data, or more detailed EMT-type models, to AEMO?

A3: Some likely costs are the additional time and effort in:

- Sourcing the EMT-related model information which is generally not available in typical manufacturer data sheet.
- AEMO requires the implementation of the EMT model in a different software format so that the entire model must be redeveloped. It can therefore be assumed that the cost for supporting AEMO would be more than double what it currently is.
- Proving to AEMO the accuracy of the modelling data.
- Conducting compliance testing and model validation.

Conclusion

DIgSILENT strongly supports more accurate modelling of the NEM but also see benefit in a more open environment that supports competition and new ideas through the availability of NEM network models in more than one software platform. A true three-phase NEM model would in our opinion be the first logical step in enhancing model accuracy.

Yours sincerely

Koos Theron
Director