10 February 2023

Australian Energy Market Operator
Submitted via email: PSMGReview@aemo.com.au

Dear Sir/Madam

Submission: Power System Model Guidelines

CS Energy welcomes the opportunity to provide a submission to the Australian Energy Market Operator's (**AEMO's**) consultation on **Power System Model Guidelines** (**PSMG**).

About CS Energy

CS Energy is a proudly Queensland-owned and based energy company that provides power to some of our state's biggest industries and employers. We employ almost 500 people who live and work in the Queensland communities where we operate. CS Energy owns and operates the Kogan Creek and Callide B coal-fired power stations and has a 50% share in the Callide C station (which it also operates). CS Energy sells electricity into the National Electricity Market (**NEM**) from these power stations, as well as electricity generated by Gladstone Power Station for which CS Energy holds the trading rights.

CS Energy also provides retail electricity services to large commercial and industrial customers throughout Queensland and has a retail joint venture with Alinta Energy to support household and small business customers in South-East Queensland.

CS Energy is creating a more diverse portfolio of energy sources as we transition to a new energy future and is committed to supporting regional Queensland through the development of clean energy hubs at our existing power system sites as part of the Queensland Energy and Jobs Plan (**QEJP**).

Key views and feedback

The NEM is changing and will continue to do so as it transitions to a market with more Variable Renewable Energy (**VRE**) and an overall lower carbon footprint. This transition will bring changes in how the NEM is managed, and CS Energy thus supports the review of the PSMG

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CS Energy in principle supports the proposed amendments to the PSMG, the Power System Design Data Sheet (**PSDDS**) and the Power System Setting Data Sheet (**PSSDS**) including input relevant to the preparation of this consultation paper.

In absence of the proposed amendments, AEMO and Network Service Providers (**NSPs**) will be unable to accurately model the NEM technical envelope, potentially compromising the delivery of power system security.

The challenge is captured in the following extract from page 7-8 of the consultation paper[1];

> *The way that asynchronous generators interact with the grid is significantly different from synchronous machines. The first major difference is that power electronic interfaces have no electro-mechanical coupling between the energy source and the grid, and as such concepts such as inertia and fault current (which were inherently provided by synchronous machines) are minimal or absent from asynchronous generators. This is detrimental to the power system, as inertia and fault current improve the stability of the system and act as stabilising services to help recovery after a disturbance.*
>
> *The second is that instead of being coupled to the grid through the laws of physics as synchronous machines are, the coupling is performed by control systems implemented as computer software. As a result, many new phenomena observed in the power system are the direct result of how the control systems have been programmed.*

AEMO has stated that the current guidelines frequently use the wording 'Generating System' which does not apply to loads. Therefore, it is considered necessary to update the Guidelines to include specific modelling requirements for large power system loads. CS Energy supports the proposed clarification and specification of the model requirements for synchronous and asynchronous generating systems and for synchronous and asynchronous loads.

In determining the threshold (if any) for deciding when to model a traditional large power system load in detail for power system simulations, be it megawatt-based, location-based or otherwise, AEMO needs to clearly articulate what it is expecting to achieve in the modelling studies including the objectives and requirements. CS Energy supports the consideration and development of a threshold that specifies the amount and detail of model information. The amount of model information associated with the threshold would reflect key parameters such as the material impact on the power system, size and investment,

> i.e. amount of model information $_{\text{threshold}}$ = f (size, material impact on the power system, and investment)

AEMO should further consider the concept and quantum of the threshold in the next stage of the consultation process on the Draft Report.

The proposed amendments to the Guidelines are formalising what appears to be happening in practice and will provide the required levels of certainty from a technical and investment perspective. The provision of adequate data on loads can at times be a challenge but for traditional motors, drives, resistive loads etc, the generic load modelling has been considered sufficient for most purposes. But, the loads that AEMO is concerned with

[1] https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/psmg-review-consultation/psmg-consultation-paper-2022.pdf?la=en

includes data centres, electrolysers, and battery systems (when charging) and should be modelled to a similar degree of sophistication that currently applies to inverters, particularly if they are very large (threshold to be determined in specifying 'large'). The challenge is specifying the model requirements that is likely to vary as a function of size and relative to yet to be determined threshold.

Accordingly, to streamline the process, AEMO should consider the categorisation of the loads into a risk spectrum that would enable the specification of model requirements to be reflective of risk spanning from a level required of inverter connected generation, and lower risk "traditional loads" for which generic modelling is considered sufficient.

A risk based approach seems reasonable for determining which loads need more detailed data. The challenge is who and how is the risk determined? This probably needs to be as objective as possible to reduce unexpected cost increases in the connection studies of new loads/batteries, so it can be planned and resourced from the beginning and prevent the requirement to be introduced at a later stage.

For example, a simplistic approach could be if the minimum planned grid Short Circuit Ratio (SCR) is less than X, then a load or battery the size of Y will be required to provide a specified level of model data information. Another key consideration is what happens in the event the grid changes and suddenly places the proponent's project inside the threshold after the proponent has completed all the connection studies, or if the proponent's plant is already connected to the network.

Historically, it has been sufficient to model load using the simple mathematical models that have been traditionally utilised. However, AEMO is correct in their statement that non-linear loads can have an impact on power system security when coupled with declining system strength and that these loads cannot be effectively modelled in the phasor domain (RMS) and must be performed in the EMT domain to obtain meaningful insights and outcomes. Harmonic studies can be done to verify its effects. Once again, the challenge emerges as to what constitutes a 'large" enough load size to fall under the EMT category of assessment. Additional challenges to be considered include the requirement to model static excitation systems (approximately 5MW)? Is it a matter of absolute load size, or measured as Total Harmonic Distortion (THD) of the non-linear current from the load with respect to the total generator/load current?

With the increasing penetration of Invertor Based Resources (IBR) in the NEM, EMT studies are deemed appropriate as the process captures the interaction of multiple and dynamic characteristics that reflect instantaneous or very fast responses arising from software programs that drive IBR where the responses are arguably not 'natural outcomes' compared to the outcomes delivered by synchronous plant.

To avoid unnecessary costs and requirement for unbudgeted resources to perform or redo studies, CS Energy would support the specification of approved models consistent with the PSMG being available to the Original Equipment Manufacturers (OEM) from the onset to ensure the provision of required information fidelity and quality of data and models provided by the OEMs. This approach would provide the appropriate levels of consistency, efficiency and optimal cost outcomes. Effectively the model requirements are pre-agreed and in most instances, would only require the modelling work to be performed on a one-off basis.

Currently the simulation model requirements apply to parties contracted for the System Restart Ancillary Services (SRAS). Does AEMO propose to extend this requirement for Local Black System Procedures (LBSP)? CS Energy would expect the simulation model

requirements for large power system loads (does a threshold apply?) to be the same for normal operation and black start conditions.

In its submission to the 2022 AEMO Remedial Action Scheme Guidelines[2] CS Energy proposed that,

> '*the modelling requirements for RAS should be included in the Guidelines with a reference to the Power System Model Guidelines for the actual details and requirements'*

The NEM technical envelope consists of the network generation systems and loads that achieves power system security partially through the utilisation and incorporation of the RAS. The number and sophistication of RAS utilisation continues to increase. AEMO's proposal to include the level of detail required for RAS models in a new section in Appendix C of the Guidelines is consistent with the CS Energy position as stated above.

If you would like to discuss this submission, please contact Henry Gorniak on 0418 380 432 or hgorniak@csenergy.com.au.

Yours sincerely

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[2] https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/publication-of-remedial-action-scheme-guidelines/further-information/cs-energy-submission.pdf?la=en