2023 GPSRR Approach Consultation Report

December 2022

Important notice

Purpose

AEMO has prepared this document to report on the consultation completed on its approach paper for the 2023 General Power System Risk Review under clause 5.20A.2(c)(3) of the National Electricity Rules.

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Version control

Version	Release date	Changes
1.0	20/12/2022	Initial release

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Contents

1 Introduction

At the commencement of its annual General Power System Risk Review (GPSRR), AEMO publishes an approach paper under National Electricity Rules (NER) 5.20A.2(c)(3), on which it must invite submissions from stakeholders.

AEMO published its approach paper for the 2023 GPSRR on 7 September 2022, and invited submissions from all interested persons. Submissions remained open until 6 October 2022.

AEMO received written submissions from Powerlink, Transgrid, the Australian Energy Regulator (AER) and CS Energy in response to the consultation, and subsequently met with the AER in November 2022. All submissions have been published on AEMO's website[1]. AEMO also invited stakeholders to an industry briefing on the 2023 GPSRR approach paper on 12 October 2022. AEMO thanks all participating stakeholders for their engagement and contributions to finalising the 2023 GPSRR approach.

AEMO published a final updated version of the approach paper in December 2022. The final approach paper incorporates changes based on AEMO's consideration of feedback received, as well as further review by AEMO on the scope of the work required to complete the GPSRR analysis.

The following sections include summaries of the stakeholder feedback received on the initial approach paper and AEMO's responses (where relevant), together with a description of the changes made to the 2023 GPSRR approach paper in response to submissions or further AEMO review.

[1] Available at https://aemo.com.au/consultations/current-and-closed-consultations/general-power-system-risk-review-approach-consultation.

2 Consultation feedback and responses

This section sets out the key items of feedback raised in each of the four written submissions received on the approach paper, as well as questions asked at the industry briefing. Appendix A1 groups stakeholder responses by reference to AEMO's consultation questions on the approach paper.

2.1 AER submission

Summary of AER comments

1. The AER indicated they supported the risk matrix approach as shown in the approach paper to identify priority risks.
2. The AER suggested a more detailed approach in the quantification of risks to guide investment option decisions, and referred to the Asset Replacement Planning industry practice application note as an example[2].
3. The AER suggested the GPSRR approach paper could better quantify the impacts of the category 3[3] events.
4. The AER considered that further clarification of the issues identified in the approach paper would be beneficial.
5. The AER considered that a Phase 2 of the Victorian under frequency load shedding (UFLS) review is required. The AER considered that the actual issues caused by priority risks need further exploration to make sure that any solutions proposed by the GPSRR are in line with the national electricity objective (NEO) and the interests of consumers.

AEMO response

1. AEMO notes the AER's support of the risk matrix approach to identify priority risks.
2. AEMO considers this feedback relevant to the 2023 GPSRR report, and plans to include an indicative assessment of the cost of each identified risk to evaluate the need for, and economic feasibility of, any recommendations.
   - AEMO agrees with the AER that an approach based on the risk cost equation in the industry practice application note would be appropriate.
   - AEMO will also include an assessment to filter options based on effectiveness, feasibility and approximate time for implementation for each recommendation in the 2023 GPSRR (where relevant and appropriate). For example, if an option is assessed not to be effective at addressing the risk, or clearly involves a significantly higher cost than the alternative options, it will be excluded by this initial filter.

[2] AER, Industry practice application note - Asset replacement planning, January 2019, p. 39, at https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/industry-practice-application-note-for-asset-replacement-planning.

[3] See Section 3.4 of the GPSRR approach paper for more details on the risk categories, at https://aemo.com.au/consultations/current-and-closed-consultations/general-power-system-risk-review-approach-consultation.

- For those recommendations identified as effective, feasible and with appropriate implementation times, AEMO plans to identify indicative costs (in consultation with network service providers [NSPs] as applicable). It should be noted that the risk/cost values included in the GPSRR report will be preliminary and more detailed analysis may be required to finalise the preferred solution and develop detailed costing.

3. AEMO agrees and has updated Section 3.5 of the 2023 GPSRR approach paper to include more detail on the selected category 3 contingencies. The detail includes the identified likelihood, potential consequences, existing management strategies and potential solutions of each contingency.
4. Section 1.4 of the approach paper outlines recommendations from the 2022 Power System Frequency Risk Review (PSFRR), including those relating to the adequacy of UFLS. UFLS is a crucial input that influences the response of the system following major events. Following on from the detail added to Section 3.5 of the approach paper, it is noted the purpose of the category 3 studies is to assess the performance of the network under the selected risk assessed non-credible events. The results of the studies are not yet known. Based on the AER's feedback and subsequent discussion, AEMO considers that no further clarification is necessary.
5. UFLS is an emergency safeguard against cascading failures and system collapse resulting from significant contingencies, and its performance is therefore a critical input to the GPSRR. The GPSRR models UFLS based on the latest information available as per Section 4.7 and 4.8 of the approach paper.
   - Growth in distributed photovoltaic generation (DPV) means that the effectiveness of UFLS schemes is declining. AEMO has dedicated significant resources towards analysis of these changes since 2019, and has a major work program ongoing to quantify risks and determine appropriate remediation measures in collaboration with TNSPs and distribution network service providers (DNSPs). AEMO reported on progress on this work program in the 2020 PSFRR Stage 1[4] (Appendix A1), and the 2020 PSFRR Stage 2[5] (Section 6.2) reports, including extensive frequency studies for South Australian separation events that demonstrate power system challenges managing non-credible events with declining UFLS availability. This program was expanded to analysis on UFLS load availability in other National Electricity Market (NEM) mainland regions (Queensland[6], New South Wales[7] and Victoria[8]), reported on individually reports for each region and summarised in the 2022 PSFRR[9] (Section 3.3.2), along with updates on the UFLS remediation actions in progress in South Australia, and further detailed analysis on South Australia separation events and UFLS challenges (Section 3.3.3 and Section 7.3).
   - AEMO's ongoing work is focused on conducting frequency studies for other regions (first Victoria, then Queensland), continuing investigation of appropriate remediation measures for South Australia, exploring remediation measures for other regions (with a particular focus on Victoria at present), and developing appropriate models, tools and methodologies for estimating long term requirements for emergency under frequency response (EUFR) in low demand/high DPV periods.

[4] AEMO (July 2020) at https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2020/psfrr/stage-1/psfrr-stage-1-after-consultation.pdf?la=en&hash=A57E8CA017BA90B05DDD5BBBB86D19CD.

[5] AEMO (Dec 2020) at https://aemo.com.au/-/media/files/initiatives/der/2020/2020-psfrr-stage-2-final-report.pdf?la=en&hash=9B8FF52E750F25F56665F2BE10EBFDFA.

[6] AEMO (December 2021) Phase 1 UFLS Review: Queensland, at https://aemo.com.au/-/media/files/initiatives/der/2022/queensland-ufls-scheme.pdf?la=en&hash=A451A3AEA814BFBB16CE0AAD185CB7FE.

[7] AEMO (December 2021) Phase 1 UFLS Review: New South Wales, at https://aemo.com.au/-/media/files/initiatives/der/2022/new-south-wales-ufls-scheme.pdf?la=en&hash=D8E106C09B66F9EAC4C6601E068784F0.

[8] AEMO (August 2021) Phase 1 UFLS Review: Victoria, at https://aemo.com.au/-/media/files/initiatives/der/2021/vic-ufls-data-report-public-aug-21.pdf?la=en&hash=A72B6FA88C57C37998D232711BA4A2EE.

[9] AEMO (July 2022) at https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/psfrr/2022-final-report---power-system-frequency-risk-review.pdf?la=en&hash=79BE593AE07E51B7E8129210D45840A6.

- Given the volume of work required by both AEMO and NSPs, and the continuing rapid pace of DPV growth causing ongoing decline in UFLS levels, AEMO considers it is appropriate to proceed with low cost remediation measures to boost capabilities where feasible and "buy time" to investigate longer-term remediation measures. Some simple low cost measures have been identified in collaboration with AusNet to boost UFLS capability in Victoria, which AEMO is working with AusNet to progress while longer-term analysis continues. Similar low cost measures have already been implemented in South Australia, and are underway in Queensland at present. AEMO will continue to report on progress on this work program through the GPSRR and other avenues.
- Based on analysis presented in the GPSRR, AEMO may identify risks relating to management of priority events and include recommendations to mitigate the impact of those events, or recommend further work to be undertaken, such as through the review of UFLS schemes.

2.2 CS Energy submission

Summary of CS Energy comments

CS Energy provided responses to the specific consultation questions included in the approach paper:

- CS Energy supported AEMO's proposal to use the 2022 *Integrated System Plan* (ISP) Step Change scenario to model future scenarios.
- CS Energy supported the risk assessment framework used in the approach paper.
- CS Energy highlighted the need to quantify the impact on the power system of category 2 events before they can be studied.
  - CS Energy questioned whether a loss of redundancy at a power station that increases the risk of single point failure/multiple unit loss would be defined as a category 2 event.
- CS Energy supported the proposed selected priority category 3 events as they demonstrate high levels of collaboration between AEMO and the transmission network service providers (TNSPs).
- CS Energy accepted the modelling approach for category 3 events, and asked if AEMO was planning to include Liddell Power Station in modelling given its planned retirement.
- CS Energy supported AEMO's proposed 2023 GPSRR consultation approach.

AEMO response

AEMO notes CS Energy's support of the approach for the 2023 GPSRR.

The trip of multiple units has been considered in the 2023 GPSRR risk assessment process. This would normally be considered as a category 3 risk, as the network impact could be significant, can be defined and studied. For example, the loss of multiple generating units at Loy Yang A Power station was studied in detail as a category 3 risk in the 2022 PSFRR.

The 2023 GPSRR historical studies will be completed using full OPDMS snapshots representing a variety of actual historical dispatch scenarios. The historical dispatch scenarios selected for this year's risk review include cases with 2, 3 and 4 Liddell Power Station units online. AEMO will consider running historical study sensitivities without Liddell Power Station (and any other retiring units) where:

a) the study result may have been influenced by the presence of the unit(s); and

b) the retirement would occur prior to the implementation of a solution.

For 2023 GPSRR future studies, AEMO will reflect announced and forecasted generator retirements/closures, and as such, Liddell Power Station will not be included.

2.3 Powerlink submission

Summary of Powerlink comments

Powerlink supported the selection of the Queensland – New South Wales Interconnector (QNI) instability for future studies and agreed that further investigation is required to determine the appropriate mitigation measures. Powerlink suggested that the remediation for the QNI instability should consider load and/or generation tripping in the neighbourhood of the contingency to arrest cascading failure rather than looking to implement a special protection scheme (SPS) within Queensland (under S5.1.8 of the NER) to maintain stability of QNI.

Powerlink recommended AEMO include composite load models in GPSRR studies to better capture load behaviour as the inclusion of static load models (in lieu of a composite load model) with distributed energy resources (DER)/DPV models may lead to overly conservative results as no complementary load tripping (other than via voltage sensitive) will occur following the large disturbances modelled.

Powerlink confirmed that the stage 2 of the model for Central Queensland – South Queensland (CQ-SQ) wide area monitoring protection and control (WAMPAC) scheme is not currently under development and recommends AEMO revise the Table 8 of the 2023 GPSRR approach paper to align with the recommendation in Section 1.3[10].

AEMO response

AEMO plans to collaborate with all NSPs and relevant generators to determine the optimal remediation options for any QNI instability issues that are identified. Options considered to maintain QNI stability will include "local" system load and/or generation tripping alongside load and/or generation tripping in Queensland or New South Wales.

For the 2023 GPSRR, AEMO has amended its approach and will use the newly developed AEMO composite load model (CMLD) which will improve the reflection of the tripping of load in response to large disturbances. This approach is now available as AEMO has resolved a compatibility issue between the AEMO CMLD and the UFLS relay model. Sections 4.9 and 4.12 of the approach paper have been revised accordingly.

AEMO has updated Table 8 in Section 4.6 of the approach paper to reflect CQ-SQ WAMPAC scheme status.

[10] Section 1.3 has been renumbered to Section 1.4 in the final approach paper.

2.4 Transgrid submission

Summary of Transgrid comments

In its submission, Transgrid recommended that AEMO includes a review of the sufficiency of existing capabilities of system operators in the context of increasing power system complexity. To support its submission, Transgrid also shared information with AEMO about Transgrid's System Security Roadmap.

AEMO response

AEMO agrees that there is the need for an uplift in technology, systems and human resourcing to help facilitate the transformation of the power system. In 2021-22, AEMO developed the Operations Technology Roadmap (OTR) which outlines the necessary uplift in operational capability to help manage an increasingly complex power system.

AEMO looks forward to working with Transgrid to include relevant findings and insights in the 2023 GPSRR.

2.5 Industry briefing session

AEMO thanks attendees of the industry briefing session for their engagement and feedback on the 2023 GPSRR approach. Below is a summary of the questions related to the approach paper at the session, and AEMO's responses.

Questions	AEMO responses
Following the QNI Minor upgrade, the QNI capacity internetwork test plan tests with QNI flows up to 1,450 megawatts (MW) south and 950 MW north. Does AEMO have any concerns about oscillations with this increase in transfers?	AEMO, Powerlink and Transgrid have collaborated to update small-signal stability limits based upon the QNI minor upgrades and additional power transfer capacity. Inter-network testing is being undertaken to monitor changes to oscillations and damping through successive increases in transfer capacity. In the context of the 2023 GPSRR, studies are planned to assess the potential for non-credible events to lead to QNI instability.
What plans does AEMO have to provide transparency regarding weather-related risks, and how can they send signals to the market to enable participants to better understand the changes and even participate to support mitigating the risks?	Weather-related risks are currently managed using a range of tools and processes such as: • forecasting and situational awareness tools, • reclassification processes, • protected events, and • special protection schemes. AEMO encourages participants to continue engaging with the GPSRR, and any subsequent work to identify opportunities to contribute to risk mitigation solutions.
A challenge for the Tasmanian island following commissioning of Marinus Link is the change to largest contingency size. There is a significant difference and more so if the capacity is released to a greater degree. How could weather-related risk be evaluated and quantified in studying the risks associated with additional capacity release?	For the 2023 GPSRR, Marinus Link is outside the modelling window and consequently these risks have not been considered this year. AEMO expects NSPs to provide updated limits advice for elements of their network that are impacted by the Marinus Link upgrade. Updates to the affected limits advice will be co-ordinated by the Marinus Link System Integration Steering Committee (SISC) as part of the inter-network testing process[B]. In terms of evaluating risks associated with weather events more broadly, AEMO has utilised the NSPs' experience and expertise together with AEMO's understanding of reviewable incidents to estimate the likelihood of weather-related risks occurring. It is becoming increasingly complex to quantify the likelihood of weather-related risks.
Generator governor models with primary frequency response (PFR) enabled is raised as a challenge in the approach paper. Is there a way that AEMO could get the cooperation of participants, even if there is not a rule obligation for the participant to update the model?	There are obligations under the NER for generators to provide updated models if they become aware, or AEMO or the NSP consider, that existing models do not accurately represent the voltage or frequency controls of the actual plant. Accurate models are critical for AEMO to be able to assess the performance of the system, particularly in the context of operating with fewer synchronous generators. AEMO has identified gaps between existing wind and solar models and actual plant performance. AEMO is aware that, where PFR is disabled on site, the models may actually over-represent the performance of the plant. AEMO will therefore make assumptions to mitigate over-estimation of frequency response. Due to the potential for inaccurate modelling information and assumptions to impact the outcomes and associated recommendations, ongoing industry effort to improve the quality and accuracy of modelling information is vital.

Questions	AEMO responses
Section 4 of the approach paper is great in terms of using the inputs but would like to see more information on the need. For example, the loss of a line might lead to a loss of load in the local area until the line is restored. That is different to the outcome where it leads to cascading system collapse.	AEMO supports this suggestion and has included additional regarding the critical risks in Section 3.5 of the final 2023 GPSRR approach paper.

A. Transgrid, Powerlink and AEMO (May 2022), QNI upgrade project – test program for inter-network test, at https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2022/qld-to-nsw-interconnector-qni-upgrade/final-inter-network-test-program-document.pdf?la=en.
B. For more details on inter-network testing and the SISC, see the published inter-network test guidelines, at https://aemo.com.au/-/media/files/stakeholder_consultation/consultations/nem-consultations/2021/inter-network-test-guidelines/internetwork-test-guidelines.pdf?la=en.

3 Other changes

AEMO has made a number of other updates to the approach paper as additional information has become available, through additional review of the scope of work required to complete the GPSRR, and for clarification purposes.

In summary, these additional changes are:

- Throughout the document, updates to change the document from a consultation phase to a final stage and to provide updates on the latest status and timeline.
- Throughout the document, clarification that financial year 2027-28 data will be used for future studies.
- In Section 3.3, updated the list of major system events to include events that occurred after the original publication date.
- In Section 3.4, added persistent oscillations causing trip of DER as a category 2 event based on observations from an incident that occurred on 23 June 2022 and discussions with the NEM Operations Committee (NEMOC).
- In Section 3.5, updated Tamworth bus coupler identifiers and section numbers based on further advice from Transgrid on the Tamworth bus coupler trip continency.
- In Section 4.3, revised the approach for the future studies to utilise a simplified model. AEMO made this change after a comparative review of the advantages and limitations of each type of model. The simplified model is comparatively simpler to set up and configure, allowing a broader range of contingencies and system conditions to be studied, commensurate with the scope of identified risks for the 2023 GPSRR. The simplified model can accurately represent system inertia, generation dispatch, regional demand and frequency response, but the 'lumping' of regional generation and load and network impedances means that voltage-related impacts can only be properly assessed with the full NEM model.

A1. Responses to consultation questions

This appendix identifies how the written submissions discussed in Section 2 relate to the questions posed by AEMO in its consultation on the approach paper.

Is it appropriate to apply the 2022 ISP Step Change scenario to assess future power system risks?

- CS Energy supported AEMO's proposal to use the 2022 ISP Step Change scenario to model future scenarios.

Is the risk assessment approach suitable to apply for future GPSRRs?

- The AER considered that the basic risk matrix approach is likely sufficient.
- CS Energy supported the risk assessment framework used in the approach paper.

What are stakeholder views regarding the need for studies associated with category 2 events as part of the 2023 GPSRR?

- CS Energy highlighted the need to quantify the impact on the power system of category 2 events before they can be studied.

Category 3 events relate to those where AEMO has identified priority events for detailed analysis. What are stakeholder views regarding the priority events proposed to be considered as part of the 2023 GPSRR, including any proposed changes to the events or the methodology for assessment?

- The AER suggested the GPSRR approach paper could better quantify the impacts of the category 3 events.
- CS Energy supported the proposed selected priority category 3 events as they demonstrate high levels of collaboration between AEMO and the TNSPs.
- Powerlink supported the selection of the QNI instability for category 3 future studies.

What are stakeholder views regarding the proposed modelling approach for the Category 3 events proposed for assessment in the 2023 GPSRR?

- CS Energy accepted the modelling approach for category 3 events, and asked if AEMO was planning to include Liddell Power Station in modelling given its planned retirement.
- Powerlink recommended AEMO use the composite load model in GPSRR studies.

Does the consultation approach meet stakeholder expectations and how would stakeholders like to engage with the GPSRR?

- CS Energy supported AEMO's proposed 2023 GPSRR consultation approach.

Other feedback

- Transgrid recommended that the 2023 GPSRR include a review of the sufficiency of existing capabilities of system operators across the NEM to maintain safe, reliable and secure operations in the context of increasing power system complexity.

Abbreviations

Abbreviation	Term	Abbreviation	Term
AER	Australian Energy Regulator	**NEMOC**	National Electricity Market Operations Committee
AEMO	Australian Energy Market Operator	**NEO**	national electricity objective
CMLD	composite load model	**NER**	National Electricity Rules
CQ-SQ	Central Queensland – South Queensland	**NSP**	Network Service Provider
DER	distributed energy resources	**OTR**	Operations Technology Roadmap
DNSP	distribution network service provider	**PFR**	primary frequency response
DPV	distributed photovoltaic (generation)	**PSFRR**	Power System Frequency Risk Review
EUFR	emergency under frequency response	**QNI**	Queensland – New South Wales Interconnector
GPSRR	General Power System Risk Review	**SPS**	special protection scheme
ISP	*Integrated System Plan*	**TNSP**	transmission network service provider
MW	megawatt/s	**UFLS**	under frequency load shedding
NEM	National Electricity Market		