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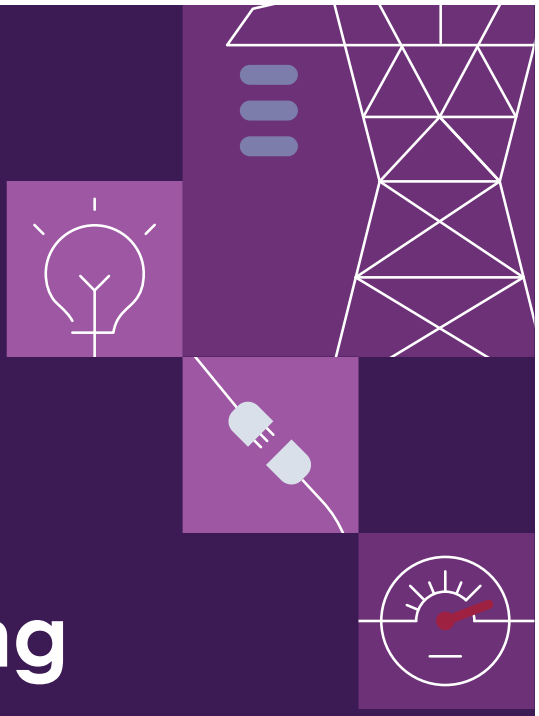

Reliability Forecasting guidelines and methodologies consultation

Final Report – Standard consultation for the National Electricity Market

Published: 24 April 2023

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Australian Energy Market Operator Ltd ABN 94 072 010 327

Important notice

Purpose

The purpose of this publication is to conclude the standard consultation procedure conducted by AEMO to review a number of reliability forecasting guidelines and methodologies

Disclaimer

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Acknowledgment

AEMO acknowledges the support, co-operation and contribution of numerous participants in providing valuable suggestions and feedback to the proposed changes.

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Executive summary

The publication of this final report concludes the standard consultation procedure conducted by AEMO to review a number of reliability forecasting guidelines and methodologies under:

- the 'Enhancing information on generator availability in MT PASA' rule change[1];
- AEMO's commitment to review processes used for projecting supply adequacy over the medium term, as specified in the market event and reviewable operating incident report for the National Electricity Market (NEM) market suspension and operational challenges in June 2022[2];
- the AER's Forecasting Best Practice Guidelines, and AEMO's Reliability Forecast Guidelines (to review AEMO's forecasting methodologies at least once every four years); and
- clause 3.9.3D(e) of the NER (to review the Reliability Standard Implementation Guidelines at least once every four years

The following guidelines and methodologies were subject to review in this consultation:

Guidelines and methodologies subject to consultation	Primary rule
Reliability Standard Implementation Guidelines (RSIG)[A]	NER 3.9.3C NER 3.9.3D
Energy Adequacy Assessment Projection (EAAP) Guidelines	NER 3.7C
Generation Information Guidelines	NER 3.7F
Medium Term Projected Assessment of System Adequacy (MT PASA) Process Description	NER 3.7.2
ESOO and Reliability Forecast Methodology	NER 3.13.3A NER 4A Parts A-C

A. AEMO intends to undertake targeted consultation required by the 'Updating Short Term PASA' rule change[3] in 2023. RSIG elements specifically relating to ST PASA have therefore not been the focus of this consultation.

A number of changes have been made to these documents to align with amended Rules requirements and improve AEMO's reliability forecasting methodologies. Minor and administrative changes related to the 'Integrating energy storage systems into the NEM' rule change (IESS Rule Change)[4] have also been made.

The main changes are:

- **Generator, integrated resource system, transmission and aggregated DER commitment criteria implementation**; which will improve AEMO's accuracy and consistency in modelling the timing of new projects coming online.
- **EAAP scenario definitions and GELF data collection**; which allows AEMO to consider the impact of energy limitations more effectively and efficiently including the impact of thermal fuel limitations.
- The annual **EAAP modelling and publication** now aligns with ESOO.

[1] See https://www.aemc.gov.au/rule-changes/enhancing-information-generator-availability-mt-pasa.

[2] See https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/2022/nem-market-suspension-and-operational-challenges-in-june-2022.pdf.

[3] See https://www.aemc.gov.au/rule-changes/updating-short-term-pasa.

[4] See https://www.aemc.gov.au/rule-changes/integrating-energy-storage-systems-nem.

- **Unplanned generator outage rate calculation methodology and collection of data for new categories**; which allows AEMO to more accurately capture all unplanned outages which have previously been unaccounted for in our model but have been relevant in past low reserve events.
- **Unplanned transmission outage calculations** will now include multiple outage categories for a single flow path where the impact of the outage categories is different, which more will more accurately reflect actual outcomes.
- **Reliability gap calculation methodology** change which more appropriately identifies reliability gap periods in which unserved energy has the highest risks for the purposes of the Retailer Reliability Obligation (RRO).
- **MT PASA unit status and recall times** to meet amended Rules requirements published by the AEMC and to allow AEMO to better understand the reasons and recall time of generators.

Contents

Tables

1. Stakeholder consultation process

As required by the 'Enhancing information on generator availability in medium term projected assessment of system adequacy (MT PASA)' rule change[5], the Australian Energy Regulator's (AER's) Forecasting Best Practice Guidelines (to review forecasting methodologies at least once every four years), AEMO's Reliability Forecast Guidelines (to review at least once every four years), and clause 3.9.3D(e) of the National Electricity Rules (NER), AEMO consulted on its reliability forecasting guidelines and methodologies.

Terms defined in the NER, and the National Electricity Amendment (Integrating energy storage systems into the NEM) Rule 2021 No. 13 (IESS Rule)[6] have the same meanings when used in this consultation paper.

AEMO's timeline and stakeholder engagement activities for this consultation are outlined below.

Table 1 Consultation steps and timing

Consultation steps	Date
Consultation paper published	31 October 2022
Workshop on energy scenarios and energy limit modelling	7 November 2022
Workshop on commitment criteria	8 November 2022
Workshop on random outage parameters and MT PASA status codes	8 November 2022
Submissions due on consultation paper	28 November 2022
Draft report, methodologies and guidelines published	3 February 2023
Workshop on draft report	13 February 2023
Submissions due on draft report	3 March 2023
Final report, methodologies and guidelines published	24 April 2023

Final guidelines and methodologies are released with this final report.

AEMO's consultation webpage, at https://aemo.com.au/consultations/current-and-closed-consultations/2022-reliability-forecasting-guidelines-and-methodology, contains all previous published papers and reports, written submissions, and other consultation documents or reference material relating to this consultation.

AEMO received seven written submissions in response to its consultation paper and seven further written submissions in response to its draft report and draft methodologies and guidelines. Throughout the consultation process AEMO held four workshops dedicated to exploring specific consultation topics, and had several meetings with stakeholders to discuss consultation topics.

AEMO thanks all stakeholders for their feedback on the consultation issues, and the draft methodologies and guidelines. AEMO has considered the submissions provided at each stage of the consultation processes, and they have enabled the preparation of this final report.

[5] See https://www.aemc.gov.au/rule-changes/enhancing-information-generator-availability-mt-pasa.

[6] See https://www.aemc.gov.au/rule-changes/integrating-energy-storage-systems-nem

2. Background

This final report concludes AEMO's consultation to review and finalise changes to a number of reliability forecasting guidelines and methodologies.

This consultation has satisfied:

- AEMO's obligations under the 'Enhancing information on generator availability in MT PASA' rule change[7].
- AEMO's commitment to review processes used for projecting supply adequacy over the medium term, as specified in the market event and reviewable operating incident report for the National Electricity Market (NEM) market suspension and operational challenges in June 2022[8].
- The AER's Forecasting Best Practice Guidelines, and AEMO's Reliability Forecast Guidelines (to review AEMO's forecasting methodologies at least once every four years).
- AEMO's obligations under clause 3.9.3D(e) of the NER (to review the Reliability Standard Implementation Guidelines at least once every four years).

Further, AEMO will implement minor and administrative changes related to the 'Integrating energy storage systems into the NEM' rule change (IESS Rule Change)[9]. In doing so, this draft report includes changes for the purposes of the *National Electricity Amendment (Integrating energy storage systems into the NEM) Rule* 2021 No. 13 (**IESS Rule**). Capitalised terms used in this draft report have the same meaning as the equivalent defined terms in Chapter 10 of the NER, including pending changes to Chapter 10 as a result of the IESS Rule Change. These changes will become effective on 3 June 2024, however AEMO considers that no material methodology impacts will arise from their inclusion and use prior to this date.

The guidelines and methodologies listed in Table 2 are subject to review in this consultation.

Table 2 National Electricity Rules associated with each Reliability Forecasting Guideline or Methodology

Guidelines and methodologies subject to consultation	Primary rule
Reliability Standard Implementation Guidelines (RSIG) [A]	NER 3.9.3C NER 3.9.3D
Energy Adequacy Assessment Projection (EAAP) Guidelines	NER 3.7C
Generation Information Guidelines	NER 3.7F
Medium Term Projection Assessment of System Adequacy (MT PASA) Process Description	NER 3.7.2
ESOO and Reliability Forecast Methodology	NER 3.13.3A NER 4A Parts A-C

A. AEMO intends to undertake targeted consultation required by the 'Updating Short Term PASA' rule change[10] in 2023. RSIG elements specifically relating to ST PASA have therefore not been the focus of this consultation.

[7] See https://www.aemc.gov.au/rule-changes/enhancing-information-generator-availability-mt-pasa.

[8] See https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/2022/nem-market-suspension-and-operational-challenges-in-june-2022.pdf.

[9] See https://www.aemc.gov.au/rule-changes/integrating-energy-storage-systems-nem.

[10] See https://www.aemc.gov.au/rule-changes/updating-short-term-pasa.

Administrative changes may also apply to other AEMO documents, such as the Spot Market Operations Timetable.

2.1. Context for this consultation

In addition to the regulatory framework outlined above, AEMO has undertaken this consultation to address areas for potential improvement identified:

- following the June 2022 market event[11] which resulted in the temporary suspension of the wholesale market, and
- following the 2022 and earlier Electricity Statement of Opportunities (ESOO) publications.

It has not been the purpose of this consultation to review the events of June 2022, or the outcomes of the 2022 ESOO, but rather to consult on forecasting guidelines and methodologies to ensure they remain appropriate in future. The identified areas for potential improvement include:

- **Better consideration of energy limitations**, and the potential for greater thermal fuel information to improve reliability and energy adequacy forecasting. This includes potential refinement of energy limitation scenarios in current guidelines.
- **Better representation of operational generation characteristics in current reliability forecasting models** to support AEMO to more accurately and comprehensively identify supply adequacy issues should participants advise of significant energy limits.
- **The inclusion in relevant methodologies of additional categories of generation outage** that were key contributors to the June 2022 market event and other recent actual market events.
- **Improved consistency in AEMO's commitment criteria** affecting new generator, integrated resource system, aggregated distributed energy resources (**DER**) and/or transmission assets to improve timely identification of reliability risks considering the availability of these assets.
- **Improvements in the methodology for calculating a reliability gap period**, indicative trading intervals, and reliability gap size for the purposes of the Retailer Reliability Obligation (RRO).

2.2. The national electricity objective

Within the specific regulatory requirements applicable to this consultation, AEMO has sought to make a determination that is consistent with the national electricity objective (NEO) and, where considering options, to select the one best aligned with the NEO.

The NEO is expressed in section 7 of the National Electricity Law as:

> *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.*

[11] See https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/market_event_reports/2022/nem-market-suspension-and-operational-challenges-in-june-2022.pdf.

Energy Ministers have proposed a change to the NEO to add a paragraph (c) in relation to Australia's greenhouse gas emissions. This proposal is currently being consulted on[12], but has not informed AEMO's consideration in this final report.

[12] See https://www.energy.gov.au/government-priorities/energy-ministers/priorities/national-energy-transformation-partnership/incorporating-emissions-reduction-objective-national-energy-objectives.

3. List of material issues

AEMO received seven written submissions as part of the first stage of consultation, and seven written submissions as part of the second stage of consultation. All submissions are published on AEMO's consultation webpage[13]:

First stage	Second stage
The Australian Energy Council (AEC)	AGL
EnergyAustralia	EnergyAustralia
ENGIE	ENGIE
Origin Energy (Origin)	Energy Users Association of Australia (EUAA)
Pacific Energy Trading (PET)	Origin Energy (Origin)
Shell Energy	Shell Energy
Snowy Hydro	Snowy Hydro

Table 3 describes the key material issues raised in submissions or consultation meetings in both stage 1 and stage 2 of the consultation.

Table 3 List of material issues

No.	Issue	Raised by	Report section
1	Consultation timeline	Stage 1: AEC, Shell Energy Stage 2: Shell Energy	Draft Report 4.1 Final Report 4.1
2	Analysis demonstrating impact of proposed methodology changes	Stage 1: Origin, AEC, EnergyAustralia, Shell Energy, Snowy Hydro Stage 2: ENGIE	Draft Report 4.2 Final Report 4.2
3	Reliance on June 2022 event	Stage 1: AEC, Snowy Hydro, EnergyAustralia, PET	Draft Report 4.3
4	Non-Scheduled participants	Stage 2: Snowy Hydro	Final Report 4.3
5	Perceived conservatism in AEMO's reliability forecasts	Stage 1: ENGIE	Draft Report 4.4
6	EAAP scenarios	Stage 1: AEC, Origin, EnergyAustralia, Shell Energy, PET, ENGIE, Snowy Hydro Stage 2: Origin, EnergyAustralia, Shell Energy, ENGIE, EUAA	Draft Report 5.1 Final Report 5.1
7	Generator Energy Limitations Framework (GELF)	Stage 1: AEC, Origin, Shell Energy, PET, ENGIE, Snowy Hydro Stage 2: Origin, Shell Energy	Draft Report 5.2 Final Report 5.2
8	2023 GELF timing	Stage 2: EnergyAustralia, Origin, Shell Energy	Final Report 5.3
9	ESOO and EAAP model and publication alignment	Stage 1: Shell Energy, ENGIE, EnergyAustralia	Draft Report 5.3
10	Publication of energy limit information	Stage 1: PET, EnergyAustralia	Draft Report 5.4
11	Application of GELF and ISP parameters to reliability forecasts	Stage 1: Shell Energy Stage 2: Shell Energy	Draft Report 5.5 Final Report 5.4
12	Hydro Modelling assumptions	Stage 1: Shell Energy Stage 2: Shell Energy, EUAA	Draft Report 5.6 Final Report 5.5
13	MT PASA LOLP modelling	Stage 1: Shell Energy	Draft Report 5.7

[13] See https://aemo.com.au/consultations/current-and-closed-consultations/2022-reliability-forecasting-guidelines-and-methodology.

No.	Issue	Raised by	Report section
		Stage 2: Shell Energy	Final Report 5.6
14	Generator and integrated resource system outage parameters	Stage 1: Shell Energy, AEC, ENGIE, Origin, EnergyAustralia, Snowy Hydro Stage 2: Shell Energy	Draft Report 6.1 Final Report 6.1
15	Data analysis from stochastic modelling	Stage 1: Shell Energy	Draft Report 6.2
16	Transmission outages	Stage 1: AEC, Shell Energy Stage 2: Shell Energy, EUAA	Draft Report 6.3 Final Report 6.2
15	Outages at major loads	Stage 1: Shell Energy	Draft Report 6.4
16	Generating and integrated resource systems commitment criteria implementations	Stage 1: Snowy Hydro, Shell Energy, AEC, EnergyAustralia	Draft Report 7.1
17	Transmission projects commitment criteria implementations	Stage 1: AEC, Shell Energy, Snowy Hydro	Draft Report 7.2
18	Aggregated DER developments commitment criteria implementations	Stage 1: AEC, ENGIE, Shell Energy	Draft Report 7.3
19	Generator, integrated resource system, transmission and aggregated DER commitment criteria implementation	Stage 2: AGL	Final Report 7.1
20	Large loads commitment criteria implementations	Stage 1: AEC, Shell Energy, ENGIE Stage 2: Shell Energy	Draft Report 7.4 Final Report 7.2
21	Reliability gap calculation	Stage 2: Shell Energy, EUAA	Final Report 8.1
22	Reliability gap in megawatts methodology	Stage 1: EnergyAustralia, Snowy Hydro, AEC, Shell Energy	Draft Report 8.1
23	Reliability gap period and trading intervals minimum percentage	Stage 1: AEC, Shell Energy, EnergyAustralia	Draft Report 8.2
24	Reliability gap period and trading intervals methodology	Stage 1: Shell Energy, Snowy Hydro, AEC, EnergyAustralia	Draft Report 8.3
25	MT PASA unit state and recall time data provision	Stage 2: Snowy Hydro	Final Report 9.1
26	Clarification of outages that could take multiple classifications	Stage 2: AGL	Final Report 9.2
27	The use of IEEE 762-2006 for reason code taxonomy	Stage 1: EnergyAustralia, PET, Origin, Snowy Hydro, EnergyAustralia	Draft Report 9.1
28	AEMO's usage of new information	Stage 1: EnergyAustralia	Draft Report 9.2
29	Use of single alphabetic input codes for submission	Stage 1: Shell Energy	Draft Report 9.3
30	PASA Availability recall period and implementation	Stage 1: ENGIE, Shell Energy, EnergyAustralia	Draft Report 9.4
31	Difficulties with long-term forecasting	Stage 1: Snowy Hydro	Draft Report 9.5

4. Discussion of general issues raised

4.1. Consultation timeline

4.1.1. Issue summary and submissions

During the first stage of consultation, Shell Energy and the AEC raised concerns about the consultation timeline being too short.

In the second stage of the consultation process, Shell Energy added additional comments about the consultation timeline, noting that in general the time allowed for consultation on the substantive changes proposed reflects only the minimum required by the Rules. Shell Energy proposed that a longer timetable should be considered to allow the widest range of stakeholders to be able to provide an appropriately considered response.

4.1.2. AEMO's assessment

When setting consultation dates, AEMO considered many factors, including NER and AER Forecasting Best Practice Guidelines (**FBPG**) requirements.

In addition to NER and FBPG requirements, AEMO held workshops to complement the issues paper in November 2022. AEMO offered and scheduled meetings with all stakeholders who made submissions as part of the first stage to further discuss the topics of interest. AEMO also held an additional workshop on 13 February 2023 to ensure that all stakeholders had the opportunity to contribute to the second stage consultation.

4.1.3. AEMO's conclusion

No extension to consultation timeframes was offered, however AEMO has taken active steps to ensure the practical involvement of all interested stakeholders.

4.2. Analysis demonstrating impact of proposed methodology changes

4.2.1. Issue summary and submissions

During the first stage of consultation, many participants requested more information on the impact of AEMO's proposed changes. Following the first stage of consultation, AEMO released draft versions of the methodologies, which included detailed specifications of the proposed processes as well as some worked examples.

In the second stage of consultation, ENGIE again requested further information on the costs and impacts of the proposed changes, particularly how AEMO accounts for the cost to consumers of over- or under- forecasting reliability risks. EnergyAustralia also noted analysis by Cornwall Insight that suggested AEMO's proposed method for commitment criteria would better align with actual commissioning dates.

4.2.2. AEMO's assessment

In the first stage of the consultation, AEMO did not provide draft versions of relevant guidelines and methodologies, so that broader concepts could be considered prior to proposed solutions being drafted.

AEMO then provided draft versions of relevant guidelines and methodologies which were designed to assist in providing the additional level of detail requested in submissions. It should be noted that some of the guidelines under consultation are not designed to provide high levels of detail, where the details are often deferred to methodologies, data collection templates, or the publications themselves.

Where possible, AEMO supplemented the draft methodologies and proposed positions with worked examples and draft templates to assist participants in understanding and reviewing the draft proposals. In other cases, AEMO did not yet have the data required from participants to prepare indicative outcomes, or doing so would have required a disproportionately large amount of work, so AEMO limited consultation to the draft methodology only.

When assessing potential methodology changes, AEMO has considered the cost to consumers of under- or over- forecasting, as well as the implementation costs, consistent with its obligation to consider feedback in the context of the NEO. AEMO has sought to not highlight reliability risks that it does not believe to be genuine, and has adjusted its proposals in response to stakeholder feedback in numerous cases throughout this consultation, to ensure that data collection and processes will reflect only those risks which are the best representation of the genuine risk of unserved energy (USE). Conversely, AEMO must adjust methodologies from time to time to ensure that reliability risks are truly reflective and correct, or consumer impacts cannot be managed with appropriate timeframes and least-cost approaches.

4.2.3. AEMO's conclusion

AEMO has provided worked examples where reasonably possible and relevant.

4.3. Non-Scheduled participants

4.3.1. Issue summary and submissions

In the second stage of consultation Snowy Hydro (Snowy) submitted that information provision obligations (including MT PASA energy limits) should be extended to non-scheduled generators, suggesting: 'This analysis is an important part of participants' assessment of their potential liabilities and opportunities from the changes in input that AEMO is assessing.' Snowy stated that there is a risk in diluting the information available about demand and supply from non-scheduled participants and that current data does not provide adequate transparency. Snowy argued although individual non-scheduled participants are small, their cumulative impact is significant.

This issue was not raised in the first stage of consultation.

4.3.2. AEMO's assessment

The requirement to submit information for MT PASA is included in NER 3.7.2(d), which only applies to Scheduled Generators or Market Participants. As the NER do not specify a requirement for non-scheduled participants to provide MT PASA information, AEMO has no power to impose such a requirement.

AEMO will continue to request data from non-scheduled generator participants for the purposes of ESOO and Energy Adequacy Assessment Projection (EAAP) forecasts consistent with materiality thresholds and relevant NER provisions.

4.3.3. AEMO's conclusion

AEMO will not request MT PASA information from non-scheduled participants, consistent with the NER.

4.4. MT PASA and 30% POE

AEMO currently models the impact on reliability of probabilistic maximum demand outcomes by sampling the maximum demand distribution at 90%, 50% and 10% probability of exceedance (POE) levels. These sampled maximum demand outcomes are then weighted to reflect the full distribution of possible outcomes. No methodology changes were proposed by AEMO, or by stakeholders in the consultation paper or first stage of this consultation.

4.4.1. Issue summary and submissions

Shell suggested that 30% POE simulations should be incorporated into reliability assessments, arguing:

> *Incorporating lower demand 30% POE demand outcome modelling in the various reliability assessments where forecast USE values will be lower will allow a more accurate allocation of probability weighting to the 10% POE modelling runs. This will more accurately represent the potential for USE in the future. It will reduce the costs to consumers of potentially unnecessary market intervention based on statistically high probability weightings for demand outcomes that only have a probability of occurring once in any ten-year period.*

4.4.2. AEMO's assessment

AEMO approximates USE by using weighted probabilities of 10% POE (30.4%), 50% POE (39.2%), and 90% POE (30.4%). As the risk of USE under 90% POE peak demand conditions is generally very low, simulations are avoided, and it is assumed that the USE under these conditions is zero.

The weightings have been derived using a mathematical approach. Expected USE was approximated using a Taylor series expansion. From three points – such as 10% POE, 50% POE, and 90% POE – the weighting for these can be derived perfectly when:

- Maximum demand POE outcomes are normally distributed.
- USE outcomes as a function of maximum demand can be approximated by a second order (or lower) polynomial.

AEMO tested the performance of this approximation as part of the introduction of these new weightings[14]. The weighted outcomes were compared with an empirical estimate for each region for a number of forecast years. The differences between weighted outcomes and empirical estimates were shown to be very small. This analysis suggests that the accuracy gained by adding an additional POE estimate is likely to be limited.

In its reliability forecasts, AEMO runs a very large number of simulations for each POE, including the impacts of multiple stochastic fixed outage rates, and multiple reference years. Inclusion of additional runs would introduce significant extra cost and complexity into reliability assessments and would therefore be inconsistent with the NEO.

4.4.3. AEMO's conclusion

AEMO will not introduce 30% POE maximum demand simulations into its reliability assessments.

[14] See Appendix A3 in the 2018 ESOO, at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NEM_ESOO/2018/2018-Electricity-Statement-of-Opportunities.pdf.

4.5. Energy limit guidance

4.5.1. Issue summary and submissions

AGL noted the additional paragraph below, which was included in Section 3.1.1 of the draft MT PASA Process Description, and requested an explanation of the meaning for hydro generator reporting requirements.

> *Energy limits should reflect output limits of scheduled generating units and scheduled bidirectional units. Energy limits must represent sustainable weekly limits that reflect the long term capability of the plant, not a limit for the week considered in isolation. For example, the impact of an energy limit being reached should not fully or near-fully deplete energy availability for subsequent weeks.*

4.5.2. AEMO's assessment

AEMO included this updated description in the MT PASA process description and Reliability Standard Implementation Guidelines as an administrative update to reflect the latest guidance from the AER[15].

The updated guidance applies to all scheduled generators and suggests that participants should submit limits that can be met in a sustainable way, and not apply limits that would result in the complete exhaustion of available fuel/water for subsequent weeks/periods.

4.5.3. AEMO's conclusion

The text included in the draft guidelines and methodologies will be retained in the final versions.

[15] See https://www.aer.gov.au/system/files/Compliance%20Update%20-%20Information%20to%20be%20provided%20to%20AEMO.pdf.

5. Discussion of material issues on energy adequacy methodology and scenarios

In the consultation paper, AEMO identified opportunities to improve reliability forecasting models to consider the impact of energy limits more effectively and efficiently. AEMO proposed:

- Alternate scenarios for consideration in the EAAP, which would be supported by new Generator Energy Limitations Framework (**GELF**) parameters to be provided by generator participants; and
- Numerous changes to energy modelling assumptions to increase the alignment between reliability, energy adequacy and planning models – specifically the ESOO, EAAP, MT PASA and *Integrated System Plan* (**ISP**) modelling assumptions.

The aim of the proposed changes was to ensure that reliability risks arising from fuel and water shortfalls that may occur for short periods of time (potentially due to supply chain or market disruptions, and the use of short duration storage) could be identified, as well as longer-term (monthly or annual) fuel availability limitations.

5.1. EAAP scenarios

In the draft report, AEMO proposed the following EAAP scenarios:

1. *Central* scenario (previously the *short-term average rainfall scenario*) – the most likely fuel availability from gas, coal, diesel, hydrogen and water resources (based on the average rainfall recorded over the past 10 years).
2. *Low Rainfall* scenario – based on the most likely fuel availability for thermal generators (as per the *Central* scenario) and considering water availability reflecting rainfall recorded in a specific historical period.
3. *Low Thermal Fuel* scenario – based on 90% POE energy availability (an estimate that is expected to be exceeded nine out of 10 years) that should consider applicable limitations for each site. While hydro participants are requested to provide energy limits consistent with the EAAP Central scenario.

5.1.1. Issue summary and submissions

Some participants still remained concerned about the definition of a 90% POE scenario and how it should be interpreted and that inconsistency would exist across participant submissions. Concerns were also raised about how these limitations should be used over the EAAP horizon.

Specific feedback received was:

- Origin remains concerned about the high degree of uncertainty that this scenario will have, as participants may interpret this differently.
- Origin also stated that some of the proposals in the draft report would not lead to improved risk assessments or better projections of potential fuel shortages. In some situations, there could be unintended outcomes, such as the EAAP over-estimating the likelihood of fuel shortages.
- EnergyAustralia noted there may be a wide range of approaches to this scenario, but if participants provide explanatory notes it should provide enough information for AEMO to use for the correct purpose.

- Shell Energy wanted further clarity on whether the 90% POE scenario energy limitations should be provided on a monthly basis for the full horizon or whether a shorter time period would be more appropriate, as while short-term fuel events do happen, make-up provisions could occur within six or 12 months.
- Shell Energy and ENGIE also raised concerns about simultaneous low thermal fuel and high rainfall leading to low output from hydro generating units.
- ENGIE, Shell Energy and the EUAA remained concerned about AEMO's ability to create additional sensitivities, and suggested that AEMO should consider consulting with stakeholders on the scope and nature of sensitivities before applying them in practice.
- EUAA expressed concern that sensitivity analysis may be conducive to artificially inflating the number of unnecessary market interventions.

AEMO notes that there were no concerns raised about the Central or Low Rainfall scenarios.

5.1.2. AEMO's assessment

In its draft report, AEMO proposed that the low thermal fuel scenario be associated with central scenario hydro inflows. It appears ENGIE and Shell Energy misinterpreted this updated specification. AEMO confirms that the low thermal fuel scenario is to be associated with central water inflows.

To address concerns with the uncertainty and different approaches in developing the participant submission, AEMO proposed that provided energy limits should represent 90% POE energy availability (an estimate that is expected to be exceeded nine out of 10 years), and should consider applicable limitations for each site, including the potential impacts of wet coal, longwall moves, train and truck deliveries, loader outages, likely market limitations and water limitations. The provided limit should not reflect a disaster situation, rather only a low estimate based on limitations that apply to each site from time to time.

While AEMO notes that this scenario still requires some degree of stakeholder judgement, AEMO considers this the best way to obtain a low fuel scenario. Tighter definitions would not be applicable to all generators, because each generator would have different types of downside risks for their site. AEMO will also use the 'Notes' provided by participants in the spreadsheet, as well as further discussions with participants where necessary, to clarify the assumptions behind their energy limits and to make sure AEMO agrees that they are fit for the purpose of the proposed scenario.

While this approach was considered as uncertain by Origin Energy, EnergyAustralia suggested that the notes should be enough for AEMO to use the data for the correct purpose.

AEMO has provided worked examples of what conditions may be considered a 90% POE fuel scenario in the GELF template and will support participants in providing this data as required.

AEMO agrees with Shell Energy that some conditions associated with 90% POE energy availability would not reasonably occur during every month over the two-year EAAP horizon. In cases where these conditions would not occur over the whole horizon, AEMO instead proposes to ask for these limits for two months (January and June) in the year, and to provide limits from the Central scenario in the other months. In situations where the conditions associated with 90% POE energy availability could reasonably occur for multiple months, participants are requested to submit energy limits for the entire 24 month horizon consistent with these conditions.

AEMO proposed to publish the three EAAP scenarios, and relevant sensitivities that may provide important insights to market and jurisdictions. Sensitivities have been used in the ESOO and EAAP in

many cases previously, particularly for identifying the benefit of additional development, or the additional risks that might be faced should specific circumstances occur. AEMO has also clarified that Low Reserve Condition (LRC) will only be declared on the EAAP Central scenario, or the scenario that AEMO considers most likely.

AEMO notes that participant input to the development of some sensitivities may be useful in some circumstances but that it will mostly not be practical. In cases where additional sensitivities are run in the EAAP, reports will clearly state the relevant assumptions and a qualitative indication of the probability of the sensitivity, where possible.

5.1.3. AEMO's conclusion

AEMO has clarified in the EAAP guidelines and GELF template:

- Where the conditions associated with 90% POE energy availability could reasonably occur for multiple months, participants are requested to submit energy limits for the entire 24-month horizon consistent with these conditions.
- Where the conditions associated with 90% POE energy availability would only reasonably occur for a duration of a month or less, participants are requested to submit energy limits consistent with these conditions for January and June each year only. All other months should be submitted consistent with the Central scenario.

As per the draft report, the low thermal fuel scenario is associated with hydro inflows/limits as per the Central scenario.

AEMO has provided examples of the conditions under which it may consider a 90% POE fuel scenario, and will work with participants to clarify any questions that they may have when they are submitting their GELF.

AEMO will state the relevant assumptions and a qualitative indication of the probability of the sensitivity (where possible) whenever sensitivities are included in the EAAP.

5.2. Generator Energy Limitations Framework (GELF)

In the draft report, AEMO proposed GELF parameters which scheduled generator participants would be required to provide, that would be specified in the EAAP Guidelines for the proposed scenarios and which would allow AEMO to understand and model energy adequacy risks more appropriately, including site-specific and multi-site risks relating to fuel supply, supply chains, and fuel market scarcity as anticipated by clause 3.7C of the NER.

Below is a summary of the GELF parameters that scheduled generator participants would be required to provide, that would be specified in the EAAP Guidelines for the proposed scenarios:

- Power station or group name (this will be defined by AEMO in consultation with each participant).
- Units included in the power station (this will be defined by AEMO in consultation with each participant).
- Type of primary fuel used (for example, coal, natural gas, hydro).
- Type of secondary fuel used (if applicable).
- Maximum capacity for each fuel type.

- Monthly minimum and maximum storage levels for primary (and secondary if applicable) fuels or reservoirs.
- Monthly expected inflows for primary (and secondary if applicable) fuel or reservoirs in megalitres (ML) or megawatt hours (MWh) (as specified by AEMO).
- Expected storage for primary (and secondary if applicable) fuel, or water at the beginning of the month in ML or MWh (as specified by AEMO).
- Monthly inflows for which a firm contract for supply applies for primary (and secondary if applicable) fuel in MWh (if requested by AEMO).
- Monthly limits on continuous operation for both primary (and secondary if applicable) (if requested by AEMO).
- Monthly limits on unit starts (if requested by AEMO).
- Monthly expected number of unit starts (if requested by AEMO).

AEMO responded to the concerns in participants' responses from the first stage of consultation by providing additional detail and reasoning on data collection requirements and their use. A draft GELF template was also made available to participants with the draft report and discussions were held with numerous participants to discuss the proposed changes.

A summary of issues from participants after these changes were considered is below.

5.2.1. Issue summary and submissions

Several participants raised concerns over the inclusion of contract data in the GELF and how it would be used. There were also additional concerns raised around the setup and clarification of variables in the GELF template.

Origin wrote that it does not support the proposed "contracted inflows" GELF parameters, suggesting that a point in time estimate of contractual positions for the next two years would not be an appropriate proxy for the fuel supply outlook or spot exposure.

Shell Energy noted that in regard to contracted input energy, it is not just currently contracted values but also anticipated contracts to cover budgeted energy forecasts that must be included. The data collection process should seek to understand all these variables, and failing to do so will result in incorrect outcomes which may negatively impact participants and consumers.

Shell Energy said that the model should only reflect generation constraints where input fuel is genuinely unavailable and should also contain provision for offsite fuel storage which could include both contractual and self-provided linepack or liquid fuel.

Origin suggested that AEMO should allow generators to submit information at an aggregated power station level (including potentially as one portfolio-level submission), rather than at the site level.

5.2.2. AEMO's assessment

AEMO agrees with Shell Energy that if offsite storage or linepack can be fully controlled by the participant, this should be taken into account. AEMO proposes to clarify that these provisions should be included when providing data for the onsite fuel storage (and would not require this as a separate parameter).

AEMO has setup the GELF template so that limits may be applied to any group of generators. AEMO has pre-selected this group, but will make changes if participants think a different grouping will be more appropriate.

AEMO appreciates that contracted quantities, expected storage levels and expected fuel inflows will change over time and will have most relevance to the next season/s and not the full EAAP horizon. AEMO also notes that contracted energy is not the same as available energy, and generators may (and do) generate more than their contracted amount. As per the draft report, it is proposed that these variables will be used for the development of EAAP sensitivities that describe the implications of potential supply chain and fuel market shortfalls on energy adequacy. AEMO believes there are situations where the contracted data will be valuable in understanding risk factors with gas and liquid fuel markets which are now tightly coupled.

5.2.3. AEMO's conclusion

AEMO has clarified the definition of onsite storage to include any linepack controlled by the participant in the GELF.

AEMO has included contracted inflows in the GELF and will apply appropriate caution and caveats to their use.

AEMO has set up the GELF to allow groupings of different generators. These groupings were populated when AEMO sent out the templates, and AEMO will work with participants to get the best grouping for their units.

5.3. 2023 GELF timing

In the draft report, AEMO proposed changes to increase the alignment between the EAAP and the ESOO, which would result in the GELF being collected in April each year.

Participants were generally supportive of AEMO's proposal but raised concerns about the timing of the 2023 GELF.

5.3.1. Issue summary and submissions

EnergyAustralia, Origin Energy and Shell Energy all raised concerns about the timing of GELF data collection for the proposed GELF collection in April 2023:

- EnergyAustralia noted that for the upcoming 2023 publications, the timing would create a challenge as the proposed guideline changes would not be finalised until 30 April. EnergyAustralia recommended that AEMO liaise with participants to ensure they understand new reporting requirements and also determine feasible reporting dates with the bringing forward of all EAAP data collection. EnergyAustralia also questioned whether it is permissible for AEMO to prescribe a data submission deadline as the same day on which those data requirements are finalised and formally communicated to affected participants. EnergyAustralia pointed out that AEMO may need to spend further time with stakeholders to validate and potentially seek consistency across the first stage of new GELF data submissions.
- Origin raised concerns that generators would need to submit the new GELF/EAAP information by 30 April, even though the final report is currently not due to be published until 28 April. Origin does not support this approach, as participants need time to understand the new data requests once the final report is published, set up new processes, and train any necessary staff. Origin noted that

complex changes to include updated implementation may require longer than a few days or weeks. Given the complexity associated with the additional data requests, AEMO should implement the new GELF/EAAP requirements in the second half of 2023 rather than in April.

- Shell Energy recommended that following completion of the consultation, AEMO should conduct data provision workshops to ensure a consistent approach by all participants in the provision of the required data.

5.3.2. AEMO's assessment

While AEMO sought to develop GELF variables that were readily at hand for most generators, AEMO appreciates concerns raised by some participants regarding the provision of new data at short notice following this final consultation report.

As suggested by participants, AEMO will offer extra assistance to participants so that they understand the data that is required and will work with participants to ensure they have an understanding of the actual data they should submit. AEMO may also need to request further explanations of the data submitted to ensure it is appropriate to include in modelling. Given the variable characteristics of many generators and participants, and the confidential nature of the specific participant questions, AEMO considers that providing individual assistance is preferable to workshops.

In cases where additional time to prepare methodologies and processes to provide new inputs is required by certain participants, AEMO has specified that participants may request an extension until 31 October 2023. This request should be made on a case by case variable by variable basis and applies only to the newly requested variables for thermal generators. In the 2023 EAAP, AEMO will note the relevant limitations of the data provided in April and May 2023, and that the quality of data provision will likely improve over time.

5.3.3. AEMO's conclusion

AEMO has initiated GELF data collection for 2023 early, allowing over five weeks of time for participants to consider the request and engage with AEMO to inform their submissions. The data collection request is noted to be completed by 5 May, which is after the publication of this final report.

In this request, AEMO has noted that participants may request an extension until 31 October 2023 on a case by case, variable by variable basis. The extension only applies to the newly requested variables for thermal generators for which additional time to prepare methodologies and processes is required.

If AEMO receives submissions in October that it believes would materially alter the 2023 EAAP, AEMO would publish an update to the EAAP in late 2023.

5.4. Application of GELF and ISP operational parameters to reliability forecasts

In the draft report, AEMO proposed that the EAAP and all reliability forecasts should apply ISP operational assumptions – as documented in AEMO's *Inputs, Assumptions and Scenarios Report* (IASR) – as relevant and appropriate for each scenario. Minimum stable levels, ramp rates, and/or minimum operational timeframes were specifically noted for consideration.

Further, AEMO proposed that reliability forecasting methodologies reflect that relevant GELF parameters may be applied to all reliability forecasts.

After submissions from the first stage, AEMO clarified that it does not intend to include all GELF parameters across the entire ESOO horizon, however seeks flexibility to include relevant parameters such as reservoir parameters, and other static operational parameters, but not the scenario-specific energy limits.

5.4.1. Issue summary and submissions

Shell Energy had several comments related to this topic:

- Expressed concern regarding the proposed change to include GELF parameters in the ESOO model and were unable to find in the revised ESOO and Reliability Forecast Methodology Document and how this change would be incorporated in the ESOO modelling process.
- Suggested that only demonstrated relevant and appropriate EAAP/GELF parameters advised by participants should be included across the entire ESOO timeframe.
- When GELF or ISP parameters are included they should be clearly documented in the ESOO and EAAP reports.
- Sought clarity regarding how AEMO would communicate outcomes associated with other EAAP scenarios and sensitivities in the combined ESOO/EAAP document.
- Requested that AEMO provide transparency when the model has removed a unit reported as available from the modelling run.

No other stakeholder concerns were noted.

5.4.2. AEMO's assessment

To provide the additional clarity about parameters included in the ESOO model, AEMO has updated the ESOO and Reliability Forecasting Methodology to list the ISP and GELF parameters which may be used in the ESOO.

Regarding AEMO's proposal to include EAAP/GELF parameters in the ESOO model, AEMO clarifies that it intends to only include relevant and appropriate GELF parameters across the entire ESOO horizon. This allows AEMO flexibility to include relevant static GELF parameters such as reservoir parameters, and other static operational parameters from the ISP. AEMO notes that it does not intend to use the scenario specific energy limits.

AEMO will document where GELF or ISP parameters have been used in the ESOO and EAAP reports.

In regard to clarifying how AEMO would communicate ESOO and EAAP outcomes in a combined document the EAAP analysis will remain independent to ESOO analysis and will be published within a section of the ESOO, and AEMO does not intend to merge ESOO and EAAP analysis.

In response to providing transparency when a model has removed a unit, the model will never remove a unit unless retired as per generator information. When a minimum stable load is set, the unit is never removed from the modelling run. There may be circumstances where a unit does not run in some periods if it does not meet this minimum load, but these periods could not be identified from modelling without significant cost and time. AEMO also clarifies that during periods of USE no generators would be turned offline due to minimum stable load requirements; an available unit would only not dispatch in these circumstances where energy limits had been reached, or when transmission constraints meant the unit's capacity was unable to be utilised to meet the consumer load.

5.4.3. AEMO's conclusion

AEMO has updated the ESOO and Reliability Forecasting Methodology to list the ISP and GELF parameters which may be used in the ESOO from time to time as relevant. AEMO will also provide details in the ESOO and EAAP reports of when GELF or ISP parameters have been used.

5.5. Hydro modelling assumptions

AEMO's hydro modelling methodology assumes that reservoir levels must return to starting levels by the end of the financial year, thereby not allowing for the sharing of water reserves between forecast years. Given that AEMO models each year in isolation, and does not optimise between forecast years, AEMO proposed no changes to this methodology.

5.5.1. Issue summary and submissions

Shell Energy and the EUAA suggested that a level of flex should be allowed between years that is reflective of that observed in the market. Shell believes this would provide a more accurate assessment of forecast USE than fixed storage levels currently used.

5.5.2. AEMO's assessment

AEMO recognises that hydro storage levels do fluctuate from year to year, however notes that AEMO's methodologies do not allow optimisation of water resources between forecast years and that including such consideration would come at a great cost of computing complexity.

AEMO notes that it has not encountered situations where this methodology has impacted energy adequacy outcomes. For example no recent EAAP has identified any additional USE due to low water inflows in the low rainfall scenario, indicating that this inflow assumption (and hence end storage level flexibility) would not impact energy adequacy outcomes.

AEMO also notes that given circumstances where an inflexible end storage level would lead to increased USE, a change to more flexible storage end levels would likely only shift USE from one year to the next.

On balance, AEMO considers that the existing methodology is fit for purpose, however should AEMO become aware that reliability outcomes may have been impacted by this methodology such as if low water inflows be associated with higher energy adequacy risks in the EAAP Low Rainfall Scenario, or hydro units are not generating due to lack of water during USE periods, then the beneficial impact of depleting storages would be tested as a sensitivity.

5.5.3. AEMO's conclusion

AEMO has updated the EAAP guidelines to specify that a sensitivity testing of the flex of storage year end levels will be undertaken in circumstances where AEMO becomes aware that reliability outcomes may have been impacted by this methodology.

5.6. MT PASA Loss of Load Probability (LOLP) modelling

AEMO proposed to adjust the methodology used in the MT PASA Loss of Load Probability (**LOLP**) run, to incorporate submitted weekly energy limits, which have not previously been considered. The MT PASA LOLP run output data is used by AEMO and market participants to understand potential reliability risks should high demand coincide with low variable renewable energy (**VRE**) output, on a daily basis over the two-year MT PASA horizon.

5.6.1. Issue summary and submissions

Shell Energy submitted that it did not support AEMO's proposal to add additional constraints, and raised that adding energy limits would result in a 'worst case' scenario for each and every day. Shell Energy noted that while it is not formally part of the reliability assessment framework, AEMO has relied on LOLP modelling outcomes in various reports and in arguing for changes to both the form and level of reliability standard.

Snowy Hydro was in support of the MT PASA LOLP change to include energy limits.

5.6.2. AEMO's assessment

AEMO considers that although this proposal imposes an extra constraint to a worst case scenario, it is an important metric to include in the LOLP run, noting that the current weekly limits in MT PASA are normally quite generous (allowing for flexibility and often overstating fuel availability if maximum energy was generated for more than one week). The MT PASA model is also able to schedule scarce available energy more optimally than observed in reality.

As the LOLP run is not used in the reliability standard assessment, it will not impact expected USE outcomes, but has the potential to highlight tight operating conditions that may arise due to submitted energy limits. AEMO does use LOLP outcomes for information purposes but is only used in conjunction with other data with an understanding of how these scenarios are designed.

AEMO also notes that LOLP metrics are sometimes used to describe the probability of USE occurring in reliability modelling but these are not based on the 'LOLP MT PASA run'.

AEMO expects that adding weekly energy limits in the LOLP run will not have a material impact on LOLP outcomes in the majority of weeks, but may highlight periods of energy supply/demand imbalance infrequently, providing market insight not currently available.

5.6.3. AEMO's conclusion

AEMO will apply the proposed methodology to include energy limits in the LOLP modelling of MTPASA as per the draft report; this will be included in the MT PASA process description. The system changes to incorporate this methodology change will be implemented by the end of 2023.

6. Discussion of material issues on random outage parameters

AEMO's reliability forecasting models use random outage parameters to simulate a variety of outage categories for scheduled generators, integrated resource systems, and key inter-regional transmission flow paths. AEMO is aware of numerous large outages that have not previously been considered in AEMO's reliability forecasts but were observed to have affected supply availability. To more accurately forecast reliability risks, AEMO proposed to include these outage categories in its reliability forecasts, and collect additional outage parameters from participants to enable this inclusion.

6.1. Generator and integrated resource system outage parameters

AEMO proposed two new categories for inclusion in generator and integrated resource system outage parameter calculations. In its draft report, AEMO clarified the proposed new categories as follows:

- *Full planned outage extension* should be submitted for any extension to a full planned outage which is non-discretionary, is extended by three days or more, and where the unit is larger than 30 megawatts (MW). Only the non-discretionary proportion of any extension should be included in this category. It is assumed that participants would consider the supply demand balance during the period of the extended outage and would schedule discretionary outages outside tight supply periods.
- *Partial planned outage extension* should be submitted for any extension to a partial planned outage which is non-discretionary, is extended by three days or more, and where unit capacity reduction is larger than 10 MW or 5% of summer capacity. Only the non-discretionary proportion of any extension should be included in this category. It is assumed that participants would consider the supply demand balance during the period of the extended outage and would schedule discretionary outages outside tight supply periods.

6.1.1. Further Issue summary and submissions

Shell Energy supported the changes proposed by AEMO to its original proposals, however noted that when considering an extension to a long duration outage which may be associated with major plant upgrades or maintenance work AEMO also consider the time at which the planned outage extension is advised to the market. Shell Energy pointed out that provision of advice to extend the outage duration towards the beginning of the outage window would be of less concern than provision of advice to extend the outage towards the end of the outage, which may not provide sufficient time for changes by other market participants.

No other participants had further comments about outage parameters in the second stage of the consultation.

6.1.2. AEMO's assessment

AEMO notes that it will be participants that determine their unplanned outage data, and agrees that the time when a planned outage is extended will be part of a participant's decision on how to categorise an outage when submitting outage data. AEMO believes that the current definition accounts for this

situation, and whether the outage extension is planned months before or days before, the participant should always have discretion if it is not to be included as an extended unplanned outage.

6.1.3. AEMO's conclusion

The definitions proposed in the first stage of consultation for planned outage extensions will be adopted. AEMO will be available to clarify specific situations with participants where it may be unclear as to how they should categorise an outage.

6.2. Transmission outages

In January 2022, AEMO consulted on its methodology for modelling inter-regional transmission unplanned outages in the ESOO[16]. As part of the AER's consultation on a T-1 instrument, in response to the 2022 ESOO and associated RRO requests published in August 2022, some stakeholders suggested that the model simplifications in the methodology used by AEMO overstated the risks and magnitudes of USE[17].

In the consultation paper[18] AEMO argued that the impact of transmission outages impacted by model simplifications were immaterial and that adding further granularity to the methodology would unreasonably increase ESOO production costs.

AEMO instead proposed to include provision in the ESOO methodology that would require AEMO to apply full granularity (both single credible contingency and reclassification constraint sets) to its ESOO and EAAP simulations only in circumstances where the outage rates forecast are likely to have a material impact on expected USE.

6.2.1. Issue summary and submissions

In the first stage of consultation, Shell Energy disagreed with AEMO's assessment, suggesting that transmission outages should be modelled explicitly at all times, and that any prejudgement of the materiality of the impact on modelling results should be avoided. AEMO argued that adjustments to the transmission outage methodology would not materially change USE outcomes, and that these adjustments would be computationally complex and expensive to implement.

In the second stage of consultation, Shell has suggested an alternative, weighted approach to calculating line losses, supported by EUAA.

An example of the Shell Energy proposal using the parameters supplied by AEMO at the June 2022 FRG meeting for the New South Wales to Queensland flow path:

Full outage rate = 0.2%

Revised line limit = 350MW approx..

Reclassification outage = 1.2%

Revised line limit = 850MW

[16] See https://aemo.com.au/-/media/files/stakeholder_consultation/working_groups/other_meetings/frg/consultations/2022/frg-consultation---unplanned-transmission-outage-rates.zip?la=en.

[17] See https://www.aer.gov.au/retail-markets/retailer-reliability-obligation/register-of-reliability-instruments/south-australia-january-february-2024/t-1.

[18] See https://aemo.com.au/consultations/current-and-closed-consultations/2022-reliability-forecasting-guidelines-and-methodology

Combine outage rate = 1.4%

Revised line limit = 779 (0.2/1.4x350 + 1.2/1.4x850)

No other stakeholders raised any issues relating to this topic.

6.2.2. AEMO's assessment

For transmission constraints, AEMO's current approach involves the application of a constraint set that applies during a single credible contingency event on the transmission segment most representative of the flow path's interconnector. Through the application of dynamic constraints that can change depending on market conditions, the results more accurately reflect the nature of the transmission outage.

Currently AEMO does not have a method of obtaining revised line limits during outages. In some situations AEMO may be able to infer a rough line limit during some outages, but this would not be a reliable and repeatable data source for reliability forecasts. As such, the method proposed by Shell Energy is incompatible with AEMO's forecasting methodology.

While AEMO previously determined that the cost of applying multiple constraint sets would be disproportionate to the forecasting accuracy gained, AEMO has now determined to implement multiple constraint sets which provides the differentiation requested by Shell Energy and EUAA.

For example, in this updated methodology the V-SA (Heywood) and QNI interconnectors will apply two different constraint sets one representing single credible contingencies, and the other representing reclassifications. Each set of constraints will have a different outage rate applied to them based on historical analysis.

The additional cost of these additional constraint sets will be low relative to the total cost of producing reliability forecasts and the impact of this change on reliability forecast outcomes will be very minor.

6.2.3. AEMO's conclusion

AEMO will apply multiple constraint sets representing the various outage categories to a single flow path where the impact on that flow path's transfer limit is materially different between categories.

7. Discussion of material issues on commitment criteria

Methodologies for commitment criteria and their implementation determine the treatment of new projects with the reliability forecasts.

7.1. Generator, integrated resource system, transmission and aggregated DER commitment criteria implementation

In the consultation paper, AEMO identified opportunities to improve the consistency of the commitment criteria implementation for new generator, integrated resource system, aggregated DER and/or transmission developments to improve timely identification of reliability risks considering the forecast availability of these assets. AEMO proposed:

- Numerous changes to generator and integrated resource systems, including the date of committed, committed* and anticipated projects to be included in reliability forecasts;
- Commitment criteria change for transmission projects to be consistent with ISP methodology and the AER's Cost Benefit Analysis (CBA) Guidelines[19]; and
- Inclusion of only those aggregated DER developments that can be identified as having met appropriate commitment criteria in the ESOO and EAAP forecasts.

Further, minor changes were proposed in the draft report in response to stakeholder feedback. Of note, AEMO proposed to apply the suggestion by Shell Energy to apply only a six-month delay to generator and integrated resource system projects that met the committed* commitment criteria. AEMO also proposed that discretion on the implementation of project delays may be appropriate in some circumstances.

7.1.1. Issue summary and submissions

Participant submissions in both the first and second stages of the consultation were generally in support of the proposed commitment criteria implementation for generation, integrated resource systems, transmission and aggregated DER.

In response to the draft report:

- AGL wrote in support of the proposed changes set out in the draft ESOO and Reliability Forecast Methodology document, suggesting that the now revised six-month delay on the availability of committed* projects and the inclusion of anticipated projects is a pragmatic and reasonable approach. AGL further suggested that AEMO's discretion is necessary given each project should be considered on a case by case basis as the outstanding factors that lead to commissioning will vary significantly.
- No other stakeholder expressed any further concerns with the revised proposal.

[19] See https://www.aer.gov.au/system/files/AER%20-%20Cost%20benefit%20analysis%20guidelines%20-%2025%20August%202020.pdf

7.1.2. AEMO's assessment

AEMO thanks stakeholders for their positive feedback on the proposed generation, integrated resource system, transmission and aggregated DER commitment criteria implementation.

7.1.3. AEMO's conclusion

The draft wording included in the draft guidelines and methodologies will be retained in the final versions.

7.2. Large load commitment criteria implementations

AEMO did not propose any commitment criteria implementations for large loads, as AEMO's demand forecasting methodologies were not the subject of this consultation. In the first stage of consultation, following feedback on the large load commitment criteria, AEMO cited the current large load commitment criteria from the Demand Forecasting Methodology[20]:

> *AEMO considers new large industrial loads that are surveyed, where a project is only considered in the 'best estimate'/Central scenario where:*
>
> - *The project has obtained the required environmental approvals.*
> - *The project has obtained approvals from the network service provider to connect to their system.*
> - *The project proponent has publicly announced that it has taken a positive final investment decision and/or the project has commenced construction.*

7.2.1. Issue summary and submissions

Shell Energy suggested amendments to the existing criteria so they more fully align with the criteria for generation and transmission/distribution projects. This suggestion was supported by EUAA. Shell Energy proposed the following amendments (in red):

- The project has obtained the required environmental and development approvals.
- The project has obtained approvals from and has signed an agreed connection agreement with the network service provider to connect to their system.
- Where applicable, the project has, (or is working towards), achieved an agreed connection performance standard.
- The project proponent has publicly announced that it has taken a positive final investment decision and has demonstrated that orders have been placed for the required plant and services and/or the project has commenced construction.

No other participants had comments about large load criteria implementations in the second stage of the consultation.

[20] See https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2022/forecasting-approach-electricity-demand-forecasting-methodology.pdf?la=en.

7.2.2. AEMO's assessment

The focus of the current Reliability Forecast consultation is limited to reliability forecasting guidelines and methodologies. The treatment of large loads is addressed within the Demand Forecasting Methodology[21]. This methodology is next under consultation in late 2023 or early 2024.

7.2.3. AEMO's conclusion

No changes have been made to the treatment of new large loads in reliability forecasts.

[21] See https://aemo.com.au/-/media/files/electricity/nem/planning_and_forecasting/nem_esoo/2022/forecasting-approach-electricity-demand-forecasting-methodology.pdf?la=en..

8. Discussion of material issues in reliability gap calculation

In the consultation paper, AEMO proposed an updated reliability gap calculation methodology to address numerous identified deficiencies with the current methodology in the 2022 ESOO. Stakeholder submissions generally agreed that the reliability gap calculation needs to change, with some suggestions and issues discussed below.

8.1. Reliability gap calculation

In the consultation paper AEMO proposed a flexible methodology, whereby AEMO must have regard to the following items when identifying the likely trading intervals and reliability gap period:

(a) Periods within the year that have a high LOLP in reliability forecast modelling (monthly and hourly analysis similar to existing processes).

(b) Periods within the year in which maximum demand is forecast to approach (for example, 99th percentile demand) the one-in-two year (50% POE) peak demand forecast (monthly and hourly analysis to complement LOLP analysis, in cases where limited sampling is biasing modelled results)

(c) The availability of standard contract periods on a suitably liquid and transparent futures market, for example contracts available on the ASX Electricity Futures Market. This may include contract periods that exclude non-working weekdays and/or periods that fall outside available standard contract periods where feasible.

In response, some participants expressed concern that the process was ambiguous and that a more deterministic process should be applied. In response, AEMO described a more deterministic methodology in the draft ESOO and Reliability Forecast Methodology. AEMO also adjusted the proposed threshold of minimum USE forecast contained in the reliability gap period from 90% to 80%.

The following process was proposed in the draft report:

1. AEMO considers standard contract periods on a suitably liquid and transparent futures market, for example contracts available on the ASX Electricity Futures Market. This may include contract periods that exclude non-working weekdays and/or periods that fall outside available standard contract periods where feasible.
2. Monthly – a forecast reliability gap is declared to exist in a month if the probability of lost load in that month exceeds 10%†. The months identified are then used to determine the start and end date of the forecast reliability gap period. – AEMO applies a 'sense test' that could widen the months included, only in circumstances where the limited sampling of reference years leads to a potentially biased outcome. For example, when USE is concentrated in just a few of the reference years and is unduly narrowing the reliability gap period. In such a case, AEMO will consider the forecast timing of maximum demand to include other months in which supply scarcity risks are also likely to occur. – AEMO applies a second 'sense test' that could tighten the start and end dates of the forecast reliability gap period within the month, if all the risk is forecast to occur in, say, the first or last week of the month.

3. Day-of-the-week – within the months that are identified in Step 2, day categories consistent with the standard contract periods are assessed and are declared as being within the forecast reliability gap period if the probability of lost load exceeds 10%†. The day-of-the-week classification is used to describe the likely trading intervals of a shortfall.
4. Time-of-day – a consistent time-of-day is applied across all month/day-of-the-week periods within a forecast reliability gap period. The range of trading intervals is identified by determining the earliest and latest time-of-day where the probability of lost load exceeds 10%†. All periods between these trading intervals are included.

† 10% or a lower percentage, decreased in 2% increments as required such that the likely trading intervals of the reliability gap period contain at least 80% of the USE forecast over the financial year. Where multiple options exist for AEMO to identify which combination of reliability gap periods and likely trading intervals to select, AEMO will have regard for:

- What it considers to be the true timing of reliability risks in the forecast year.
- The standard contract periods available to retailers, and the additional costs that may be incurred from a potentially wider gap period.

The forecast reliability gap period may contain months which do not meet the lost load thresholds described above. AEMO applies the following treatment in issuing reliability instrument requests:

- Where there is no consecutive two-month period that does not meet the threshold (for example, November, January, and March are above the lost load threshold but December and February are not), a single reliability instrument request is made which includes the month/s which did not meet the threshold. However, these month/s are explicitly excluded from the likely gap trading intervals.
- Where there is a consecutive period of two or more months that does not meet the threshold, two reliability instrument requests are submitted with different forecast reliability gap period specifications. For the purpose of calculating the megawatt size of the forecast reliability gap, the two or more forecast reliability gap periods are considered together, due to the need to assess the additional megawatts required to meet the annual reliability standard.

As indicated above, if there is a single month or another period (for example, the weeks over the holiday period) where the risks of load shedding are observed to be low in the simulations, this period is explicitly excluded from the likely gap trading intervals. This removes the possible need for contracting cover during periods where the risk of load shedding is low while maintaining the administrative simplicity of a single reliability instrument request in most cases.

This attempts to balance the cost of contracting for longer forecast reliability gap periods against the risk of confusion and administrative burden if multiple reliability instrument requests are requested in the same financial year.

8.1.1. Issue summary and submissions

Shell Energy and EUAA both still had concerns about AEMO's approach while EnergyAustralia requested more analysis relating to the calculation of the RRO gap methodology change.

Shell Energy and EUAA were concerned that the arbitrary setting of the gap period to capture 80% of USE, combined with the use of contracts and flexibility in its methodology would result in extended gap periods in some jurisdictions, which would not be efficient nor economic.

Shell Energy and EUAA did not believe AEMO should use contract periods to influence the duration of a reliability gap period and suggested that AEMO should only declare the minimum gap period required to meet the relevant reliability threshold and leave participants to determine their optimum contracting strategy to meet their RRO obligations.

Shell Energy made several statements about what AEMO's reliability gap period would be based on a recent MT PASA run:

> *"based on information set out in the latest weekly MTPASA update, that 99% of USE forecast in the March 2023 to February 2024 period in South Australia occurs in January 2024. For NSW in the period April 2024 to March 2025, the reliability gap period would extend from June 2024 to February 2025 to achieve the 80% capture threshold. In Victoria for the period April 2023 to March 2025, the period November 2023 to March 2024 would need to be declared gap months. The variability in outcomes would suggest that the proposed trigger may not provide the consistency in outcomes sought by AEMO or one acceptable to participants and consumers who bear the economic burden of any declared gap period."*

Shell Energy proposed the following methodology for calculating the gap period, which was endorsed by EUAA:

- Use the 80% trigger threshold as proposed but amended to exclude any months where the forecast USE in that month is less than 10% of the yearly total.
- Include only months where the calculated USE value exceeds 0.024% and only trading intervals in that month where the forecast USE exceeds 10% of the total trading intervals in the month.

Shell Energy argued that the above methodology would ensure that a reliability gap period included only those periods that were warranted and would reduce costs to consumers and the regulatory burden on participants.

In relation to South Australia, Shell Energy noted that combined Victoria plus South Australia peak demand has occurred in January in eight of the past 12 years. Data from the modelling should set the periods where USE may occur and not subjective concerns as such as use of contracts and potential use of maximum demand variation as proposed by AEMO. Shell Energy would only support an expansion of the gap period where it was based on robust analysis supported by data.

8.1.2. AEMO's assessment

AEMO was unable to replicate the assessment undertaken by Shell Energy using the published MT PASA information. AEMO notes that, based on recent MT PASA runs (January to March 2023) and 2022 ESOO analysis:

- Recent gaps identified in the 2022 ESOO for New South Wales in 2025-26 were for 1 December 2025 – 28 February 2026 and 1 June 2026 – 30 June 2026; the gap period did not include all the months in between. The proposed methodology in the draft report would continue to remove months where low USE outcomes occur. 2022 ESOO modelling showed no periods of risk between August and November, hence they would not be included in a reliability gap in the next five years.
- The amount of forecast USE in South Australia is high in January 2024, and has been as high 99% of USE in the March 2023 to February 2024 period in some MT PASA runs. This observed modelling outcomes is one of the drivers for AEMO's change to include other drivers in the RRO gap period methodology, as AEMO considers that the limited sampling of reference years has driven this outcome, which is not reflective of the true nature of risks in South Australia.

- The Victorian gap suggested by Shell Energy from November 2023 to March 2024 does not seem well aligned with recent MT PASA or ESOO data, which would likely suggest a narrower gap period.
- In most recent MT PASA runs the expected unserved energy is below the IRM. The distribution of USE will often change as it increases in size.
- Although AEMO does not expect the variability of regional outcomes to be as extreme as Shell's examples, it does believe that the period of risk needs to be appropriate based on each region's ability to meet demand throughout the year (as identified in the detailed reliability modelling).

The methodology proposed by Shell Energy does not provide enough detail to properly consider its use to calculate reliability gap periods, but AEMO notes the following concerns:

- Including only months that exceed 0.024% could result in difficulty identifying reliability gap periods in some circumstances, even if annual expected USE is forecast above the relevant reliability standard. One month having 0.024% USE roughly corresponds to annual rate of 0.002%, this means often no months will be at this level and should annual USE is between 0.0006% and 0.002%, it is likely that no months to be above this level. AEMO also notes circumstances where two months with high USE of 0.02% with would result in annual USE of over 0.003% but no months would be identified using the proposed threshold.
- Ensuring that at least 80% of forecast USE is within the reliability gap period is important to ensure AEMO is including all high risk periods. For the reasons identified by AEMO in the draft report, excluding months and trading intervals so less USE is included in the reliability gap period is counterproductive to its purpose. Excluding extra periods may result in a narrow gap and exclude periods where reliability risks are likely and would not meet the requirements of the NEL and NER.
- AEMO considers the use of probability thresholds rather than measures of USE percentages as a better measure to assess times of reliability risk.

In relation to Shell Energy and EUAA concerns about AEMO's flexible methodology and the use of contracts to define the gap period:

- AEMO intends to use this flexibility only in certain cases where biases arising from the limited sampling of reference years are noted (for example, South Australian outcomes in the 2022 ESOO).
- AEMO expects that this flexibility will be used less when additional reference years are modelled.
- In cases where AEMO intends to use its discretion it will include appropriate analysis reasoning behind its decision. Shell Energy noted that it would support expansion of the gap period where robust analysis was supported by data. AEMO will include a requirement to include analysis to support its inclusion of extra months in the ESOO and reliability forecast methodology document.

In relation to Shell Energy's comment about combined South Australian and Victorian peak demand occurring during January in eight of the 12 past years, AEMO notes:

- The contribution of VRE also plays an extremely important part in USE, especially in South Australia, so this analysis would be most relevant if focused on 'residual demand', that is once taking into account demand minus VRE.
- In four out of the last 12 years maximum demand did not occur in January, meaning there is a risk in other months in 25% of the reference years used in the 2022 ESOO modelling.

- AEMO notes that bias is evident due to the use of only 12 reference years in South Australia, especially given the need to consider the correlation between South Australian demand, South Australia VRE and Victorian demand. AEMO is working towards using a larger number of reference years in future.

To address EnergyAustralia's request for further analysis, AEMO looked at the gap periods identified in the 2022 ESOO and found that 10 out of the 14 gap periods identified would likely remain unchanged. Of those reliability gap periods that would be subject to change, two were in South Australia, and two were in New South Wales.

AEMO also provided a worked example of the RRO gap methodology in the ESOO and Reliability Forecast Methodology Document.

8.1.3. AEMO's conclusion

AEMO has adjusted the ESOO and Reliability Forecast methodology such that should discretion be used to adjust the RRO gap period from the deterministic method, analysis to support the decision will be published.

9. Discussion of material issues on MT PASA unit status and recall times

The 'Enhancing information on generator availability in MT PASA' rule change was one of the Energy Security Board's (ESB's) post-2025 recommendations to improve resource adequacy outcomes in the NEM. The final rule was published by the Australian Energy Market Commission (AEMC) on 18 August 2022. The rule builds on existing MT PASA requirements, which require scheduled generators and other market participants to indicate how many megawatts they could make available each day over the medium-term horizon (between seven days and 36 months into the future). In addition to providing the megawatt availability, the final rule requires scheduled generators and integrated resource systems to also provide current intentions and best estimates of a:

- Unit state – that is, a scheduled generating or integrated resource system's availability or unavailability and the reason for its availability or unavailability. The unit state must distinguish between a physical and economic reason for unavailability.
- Unit recall time – to indicate the period in which the plant could be made available under normal conditions after a period of unavailability.

AEMO proposed a solution based on the international standard IEEE 762-2006, which was supported by stakeholder submissions in the first and second stages of consultation. AEMO received two submissions in the second stage of the consultation regarding the draft report and draft guidelines and methodologies, which are discussed below.

9.1. MT PASA unit state and recall time data provision

9.1.1. Issue summary and submissions

Snowy Hydro argued against the requirement to submit unit state and recall time as part of MT PASA submissions. It said: *We are unclear about benefits AEMO will achieve from this additional information which will increase the burden on participants.*

This echoed concerns raised during the first stage of consultation, in which Snowy Hydro submitted that *any unit status greater than one year is likely to be inaccurate and unhelpful*.

No concerns were raised by other stakeholders regarding the draft proposal for MT PASA unit status and recall time data provision requirements.

9.1.2. AEMO's assessment

The requirement to provide recall times for a 36-month period for scheduled generating units is included within the 'Enhancing information on generator availability in MT PASA' rule change and AEMO is obliged to collect this information. Under the amendments to clause 3.7.2(d) of the NER, participants will be obliged to submit this information for a period of 36 months based on their 'current intentions and best estimates'.

9.1.3. AEMO's conclusion

From October 2023, participants will be required to provide recall reason codes and recall times for a period of 36 months under revised NER requirements.

All other elements of the draft proposal for MT PASA unit status and recall times will be retained and reflected in the final guidelines and methodologies.

9.1. Clarification of outages that could take multiple classifications.

9.1.1. Issue summary and submissions

AGL wrote in support of the proposed unit state classification but requested clarification under a specific set of circumstances. Specifically, clarification was sought as to how a market participant should report a generator forced outage where the maintenance to rectify the fault is delayed for economic reasons.

9.1.2. AEMO's assessment

In circumstances where multiple outage codes could apply, participants should submit the single outage code that is most representative. To assist with the specific circumstances described by AGL, AEMO will add additional examples in the MT PASA process description that seek to cover similar circumstances.

9.1.3. AEMO's conclusion

AEMO has added an example to show how a participant may report this outage in the MT PASA process description.

10. Final determination on proposal

AEMO has prepared final versions of each relevant guideline and methodology which reflect the above conclusions. These are published alongside this final report.