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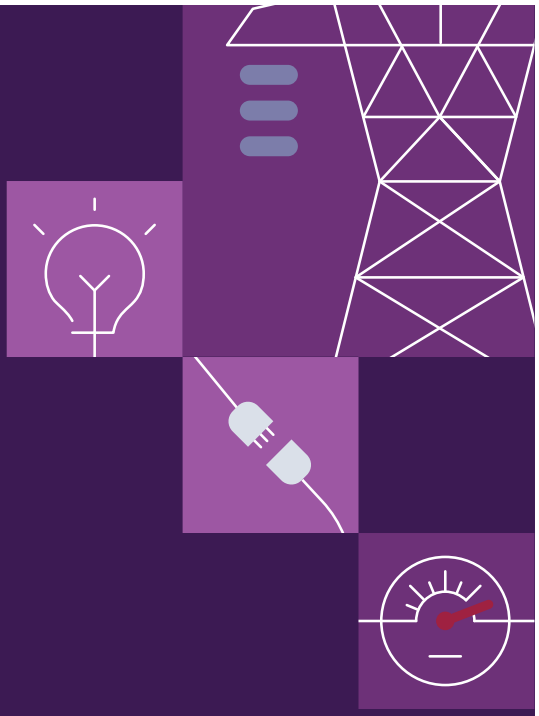
AUSTRALIAN ENERGY MARKET OPERATOR



Changes to Reserve Level Declaration Guidelines

Draft Report – Expedited consultation for the National Electricity Market

Published: 20 February 2024

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New South Wales | Queensland | South Australia | Victoria | Australian Capital Territory | Tasmania | Western Australia

Australian Energy Market Operator Ltd ABN 94 072 010 327

Explanatory statement and consultation notice

The publication of this draft report commences AEMO's expedited consultation on changes to the Reserve Level Declaration Guidelines (**Guidelines**) (the **proposal**) under the National Electricity Rules (**NER**).

This consultation is undertaken as required by NER 4.8.4A(e), following the procedure in NER 8.9.3. AEMO is required by NER 4.8.4A(e) to follow the expedited rules consultation procedure for amendments to the Guidelines unless the changes are limited to those of a minor or administrative nature.

AEMO considers that the expedited rules consultation procedure is appropriate to the proposal, and that it should be considered a Non-material Proposal, not of a minor or administrative nature, for the following reasons:

- it includes a new quantile regression (**QR**) model to calculate the Forecast Uncertainty Measure (**FUM**) with the addition of a new input predictor, but does not change the output materially; and
- it otherwise contains only minor drafting updates (such as terminology and references) for consistency and accuracy.

AEMO has prepared this draft report to describe the proposed model with the new input predictor and reasons for the update.

AEMO produces the FUM which is used in conjunction with the largest and the second largest contingency in NEM regions to determine the Lack of Reserve (**LOR**)1 and LOR2 trigger levels. The FUM is currently produced using a probabilistic model called the Bayesian Belief Network (**BBN**) which operates on a software application provided by an external vendor.

To improve resiliency and reduce operational risks related to externally provided software applications, AEMO is proposing to update the model with an in-house alternative Machine Learning (**ML**) solution using QR, with the addition of a new input predictor (time-of-day) to better capture the uncertainty effects of solar generation. Replacing the existing BBN model with a QR model with the addition of time-of-day as an input predictor does not materially change the calculated FUM value. Therefore, the resulting LOR levels being determined are reasonably similar as those determined by the BBN model.

AEMO's draft proposal is to amend the Guidelines in the form published with this draft report, with a proposed effective date of 22 May 2024.

Consultation notice

If any person considers that AEMO should follow the standard (rather than expedited) consultative procedure for this proposal, they can submit a request for AEMO to do so (a **procedure change request**) within 10 business days after publication of this draft report. Any procedure change request must be sent to **operationsstakeholders@aemo.com.au** by

5:00pm (AEDT) on 5 March 2024. In accordance with NER 8.9.3(b), a request must include reasons why the person considers the proposal is not a 'Non-material Proposal' as defined in NER 8.9.1 – that is, why it would have a significant effect on the NEM or on the activities of a relevant group of registered participants.

AEMO invites written submissions from interested persons on this draft report and the draft proposal to **operationsstakeholders@aemo.com.au** by 5:00pm (AEDT) on 19 March 2024.

Submissions may include alternative or additional proposals you consider may better meet the objectives of this consultation and the national electricity objective in section 7 of the National Electricity Law. Please include supporting reasons.

Before making a submission (including a procedure change request), please read and take note of AEMO's consultation submission guidelines, which can be found at https://aemo.com.au/consultations. Subject to those guidelines, submissions will be published on AEMO's website.

Please identify any parts of your submission that you wish to remain confidential, and explain why. AEMO may still publish that information if it does not consider it to be confidential, but will consult with you before doing so. Material identified as confidential may be given less weight in the decision-making process than material that is published.

Submissions received after the closing date and time will not be valid, and AEMO is not obliged to consider them. Any late submissions should explain the reason for lateness and the detriment to you if AEMO does not consider your submission.

Interested persons can request a meeting with AEMO to discuss any particularly complex, sensitive or confidential matters relating to the proposal. Please refer to NER 8.9.1(k). Meeting requests must be received by the end of the submission period and include reasons for the request. AEMO will try to accommodate reasonable meeting requests but, where appropriate, we may hold joint meetings with other stakeholders or convene a meeting with a broader industry group. Subject to confidentiality restrictions, AEMO will publish a summary of matters discussed at stakeholder meetings.

Contents

Tables

Figures

1. Stakeholder consultation process

As required by National Electricity Rules (**NER**) 4.8.4A(e), AEMO is consulting on changes to the Reserve Level Declaration Guidelines (**Guidelines**) (the **proposal**) in accordance with the expedited rules consultation procedure in NER 8.9.3.

Note that this document uses terms defined in the NER, which are intended to have the same meanings. There is a glossary of additional terms and abbreviations in Appendix A.

AEMO's process and expected timeline for this consultation are outlined below. Future dates may be adjusted and additional steps may be included as needed, as the consultation progresses.

Table 1 Consultation process and timeline

Consultation steps	Dates
Draft report published	**20 February 2024**
Procedure change request deadline	**5 March 2024**
Submissions due on draft report	**19 March 2024**
Final report published	**2 May 2024**

AEMO considers that the expedited rules consultation procedure is appropriate for the proposal because it is not expected to have a significant impact on either:

- the NEM wholesale market or power system, because the FUM value produced by the proposed QR model with the addition of a new input predictor (time-of-day) does not yield a materially different FUM value to what the existing BBN model produces therefore, no material changes to the number of forecast LOR1 and LOR2 conditions declared. Furthermore, no changes are proposed to the process of determining LOR1 and LOR2 trigger levels; or
- the activities of the group[s] of registered participants that the proposal relates to, because there are no changes to data structures, processes or systems that participants use.

At any time before the final report is published, and based on information received through submissions to this draft report, any procedure change requests under NER 8.9.3(b) or otherwise, AEMO may decide that the proposal can no longer be considered non-material. If so, AEMO will switch to the standard consultation procedure by publishing a notice under NER 8.9.3(f).

AEMO's consultation webpage for the proposal is on AEMO's website[1], which will contain all previous published papers and reports, written submissions, and other consultation documents or reference material (other than material identified as confidential).

[1] Found at https://www.aemo.com.au/consultations/current-and-closed-consultations/2024-Consultation-on-changes-to-Reserve-Level-Declaration-Guidelines

2. Background

2.1. Context for this consultation

The initial version of the Guidelines was developed through a consultation process in late 2017 and was subsequently published in December 2017, taking effect from 16 February 2018[2]. A subsequent consultation was undertaken in July 2018 regarding changes to the definition of Regional Excess Supply (**RXS**), the inputs used to determine prevailing conditions, and the confidence levels used to determine the FUM. This resulted in the second version of the Guidelines being published with effect from 12 December 2018[3].

Most recently, AEMO undertook a review of the Guidelines in August 2023. This review found no material issues with the interpretation or application of the current Guidelines. However, in 2021-22, AEMO had also identified the need to amend the Guidelines and several other AEMO instruments to implement the ST PASA Replacement Project[4]. A rule change was made in 2022 to facilitate this project, effective from 31 July 2025. AEMO is targeting consultation on these instruments in 2024 and intends to conduct a further review of all aspects of the Guidelines within the scope of that consultation.

This proposal, however, is separate and seeks to update the Guidelines to reflect a different modelling engine used and single additional input variable to calculate the FUM. The purpose of this is to reduce external-vendor risk that the BBN application runs on by AEMO building its own in-house QR model to calculate the FUM.

At the same time, AEMO proposes to make minor and administrative updates to the Guidelines identified in the August 2023 review and subsequently, including during this consultation.

A summary of the proposal is provided in Section 3 below.

2.2. NER requirements

Clause 4.8.4A of the NER requires AEMO to "make and publish guidelines (reserve level declaration guidelines) that set out how AEMO will determine a lack of reserve condition".

The Guidelines are required to:

1. describe how AEMO continually assesses the probability of capacity reserves being insufficient to avoid load shedding (other than the reduction or disconnection of interruptible load) given reasonably foreseeable conditions and events (probability assessment);

[2] Found at https://aemo.com.au/en/consultations/current-and-closed-consultations/consultation-on-initial-version-of-reserve-level-declaration-guidelines

[3] Found at https://aemo.com.au/en/consultations/current-and-closed-consultations/changes-to-reserve-level-declaration-guidelines

[4] Found at https://aemo.com.au/initiatives/trials-and-initiatives/st-pasa-replacement-project

2. describe how the probability assessment applies in relation to different periods of time;
3. specify at least three probability levels at which AEMO will declare a corresponding lack of reserve condition in relation to a specified period of time, indicating an increasing probability of load shedding (other than the reduction or disconnection of interruptible load).

NER 4.8.4A(b)(4) requires the Guidelines to be reviewed by AEMO at least once every four years. The process by which the Guidelines are to be amended is set out in NER 4.8.4A(d) and (e) and in accordance with the expedited rules consultation procedure provisions in NER 8.9.3.

2.3. The national electricity objective

Within the specific requirements of the NER applicable to this proposal, AEMO will seek 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; and
>
> (c) the achievement of targets set by a participating jurisdiction—
>
> (i) for reducing Australia's greenhouse gas emissions; or
>
> (ii) that are likely to contribute to reducing Australia's greenhouse gas emissions.

3. Proposal discussion

This section provides a summary of the proposed changes to the Guidelines which relate to the underlying FUM model and its inputs and outlines the rationale for these changes. These proposed changes:

- replace the current BBN model with an alternative in-house ML model using QR to calculate the FUM; and
- add a single input variable to calculate the FUM.

Neither of these proposed changes would impact upon the intent of the current Guidelines. The main updates required to the Guidelines to reflect these changes are to the detail surrounding the model and inputs used to create the FUM value as it currently stands, as outlined in Appendix A of the Guidelines.

In addition, minor drafting updates throughout the Guidelines have been included for consistency and accuracy, to reflect changes resulting from Five-Minute Settlement (5MS) and Semi-Scheduled Generator's available capacity.

3.1. Change proposed to the underlying FUM model and model inputs

AEMO proposes to amend Appendix A of the Guidelines by replacing the current model used to produce the FUM with a new model, and with the addition of a new predictor (input) variable.

The FUM is currently produced using a probabilistic model called the BBN which operates on an application provided by an external vendor. To improve resiliency and reduce operational risks related to externally provided software applications, AEMO is proposing to update the BBN model with an alternative ML solution using QR that will be run and hosted on AEMO's systems. The QR model has been trained with the same data set used to train the current BBN model, with the addition of a new input predictor. The data set includes the following input variables, with variables (a) to (e) representing existing BBN inputs and variable (f) representing the new input variable data, dating back to 2012:

a) Forecast of dry bulb temperature

b) Solar irradiance forecast

c) Forecast output of semi-scheduled generating units

d) Current demand forecast error

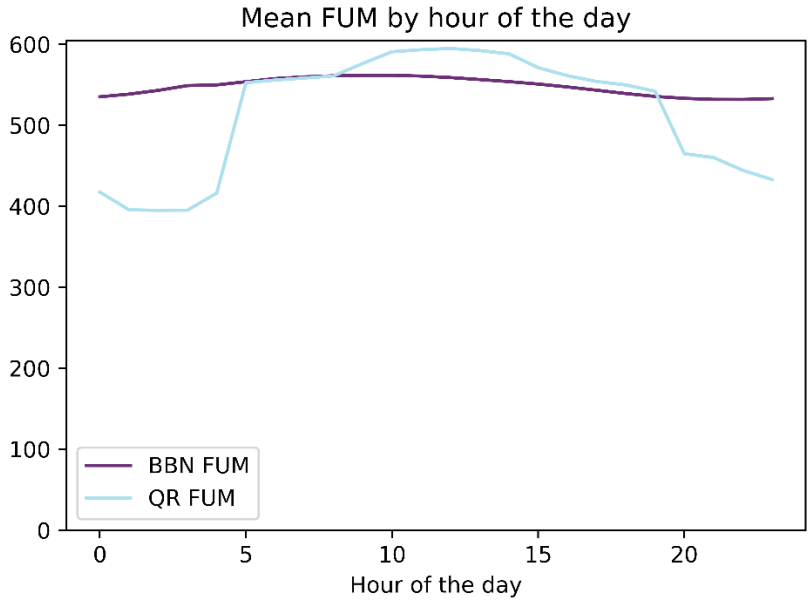
e) Current supply mix for coal, gas and hydro

f) Time-of-day

The addition of the time-of-day input variable leads to lower average FUM values during the night compared to during the day, as seen in Figure 1. This is likely influenced by the

uncertainty in predictions of solar generation from semi-scheduled generators and residential rooftop PV systems. Importantly, the proposed QR model can more accurately predict the decrease in uncertainty of the FUM during the critical transition from afternoon to evening. This is shown by the decrease in average QR FUM value from the 18:00th hour in the figure below.

Figure 1 Mean FUM value (in MW) across all NEM regions by hour of the day in 2023.



To understand how this difference in FUM values across the two models translate into real-world LOR assessments, Figure 2 below shows the number of days in 2023 where a forecast LOR2 is set by the FUM i.e. when the FUM is greater than the Largest Credible Risk (**LCR**). Both FUM models yield the same result for TAS and VIC regions, with the remaining regions having slightly lower trigger days with the QR model compared to the BBN model (NSW = 8 less days, QLD = 1 less day, SA = 5 less days).

Figure 2 Number of days in 2023 where a forecast LOR2 is set by each FUM model.

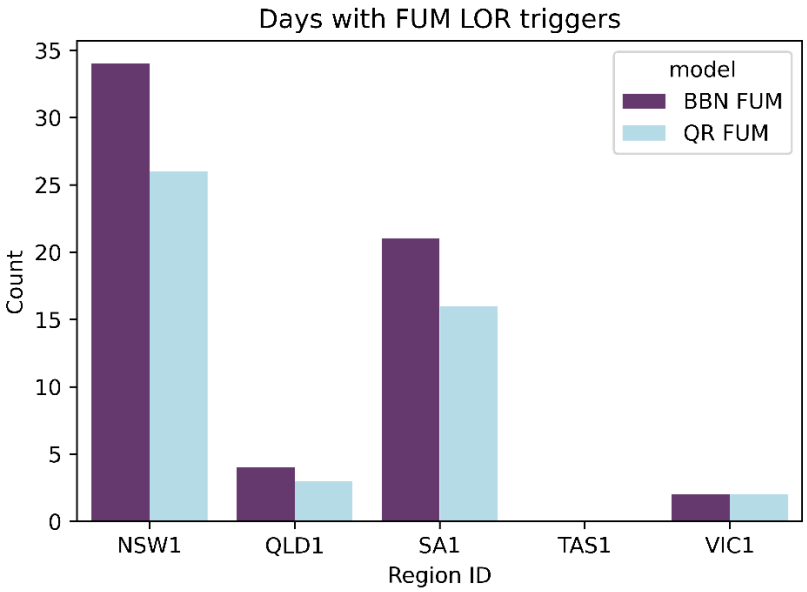


Table 2 below provides a breakdown of the days in 2023 where differences are observed between both models, where the value shown is the count of half-hourly intervals with LOR2 triggers. In most cases, the interval count within each model and difference between the models is small (less than 5), indicating that this difference between the models is not significant. The minimum forecast horizon for a given trading day[5] is typically 48 hours or greater, indicating that the difference between the models does not usually occur for shorter forecast horizons.

Table 2 Difference in the count of half-hourly intervals in 2023 triggering a forecast LOR2 by each FUM model.

Region ID	Trading date	BBN model count	QR model count	Min forecast Horizon (hours)
NSW1	18/01/2023	1	0	48
NSW1	11/02/2023	0	1	28
NSW1	30/04/2023	4	0	48
NSW1	01/05/2023	1	0	72
NSW1	05/05/2023	2	0	31
NSW1	08/05/2023	1	0	24
NSW1	24/05/2023	2	0	70
NSW1	29/05/2023	2	0	72
NSW1	13/11/2023	3	0	46
NSW1	11/12/2023	1	0	72
QLD1	16/03/2023	1	0	72
SA1	13/01/2023	0	3	64

[5] This is a defined NER term.

Region ID	Trading date	BBN model count	QR model count	Min forecast Horizon (hours)
SA1	27/01/2023	0	1	12
SA1	16/02/2023	0	1	3
SA1	17/05/2023	1	0	47
SA1	26/06/2023	21	0	47
SA1	19/07/2023	0	5	54
SA1	22/07/2023	9	0	65
SA1	04/08/2023	2	0	71
SA1	11/08/2023	4	0	29
SA1	12/08/2023	3	0	35
SA1	16/08/2023	1	0	57
SA1	17/08/2023	19	0	64
SA1	31/08/2023	9	0	59

In SA, there are two trading days where the half-hourly interval count for the BBN FUM is noticeably higher than the other trading days. On 26 June 2023 and 17 August 2023, the BBN FUM has a count of 21 and 19, respectively, whereas the QR FUM has a count of 0 in both cases. This can be visualized in Figure 3 where the capacity reserve forecast dips below the BBN FUM and remains above the QR FUM on two separate instances on 26 June 2023. This is also the case on 17 August 2023 as shown in Figure 4 below, with the difference in LOR triggers occurring for forecast horizons of at least 48 hours for in trading days. Note that this is for a single forecast runtime and the shape will change slightly for successive forecasts. Also plotted is the ‘Capacity Reserve Actual’ which is the recorded capacity reserve following the period being assessed. Other dates in the table above where the BBN Model count is greater than 5 shows similar behaviour with the ‘Capacity Reserve Forecast’ briefly dipping below the BBN FUM.

Figure 3 Calculated FUM values from both models against forecast and actual capacity reserves in SA for a single forecast runtime covering 24-27 June 2023.

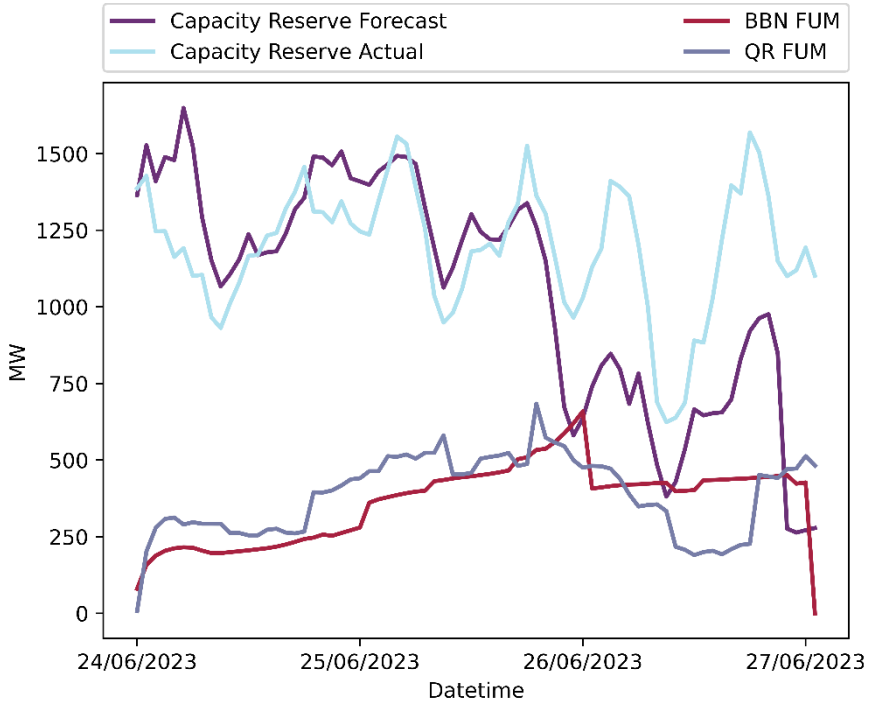
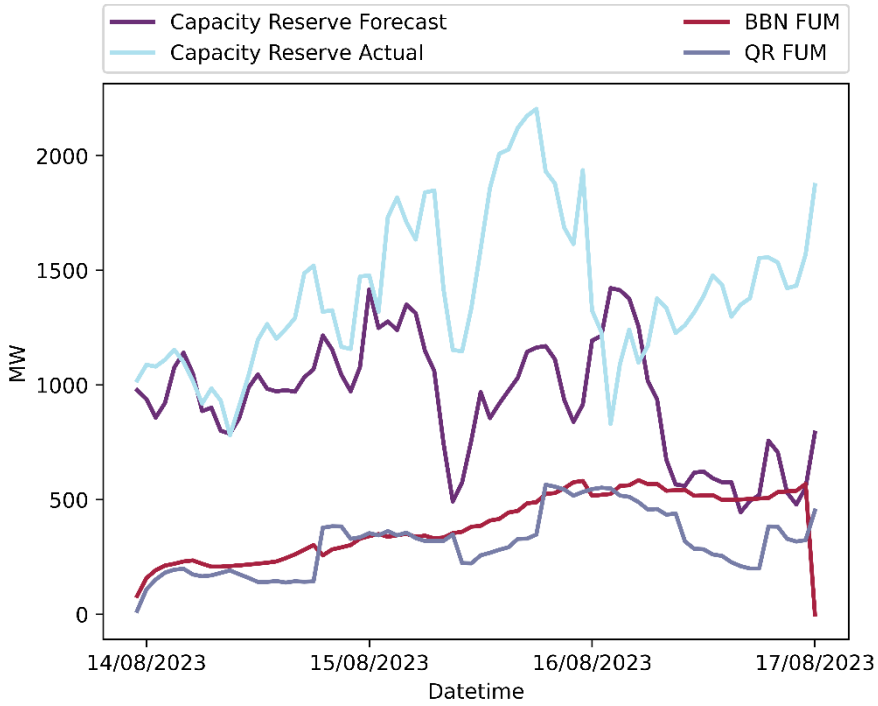
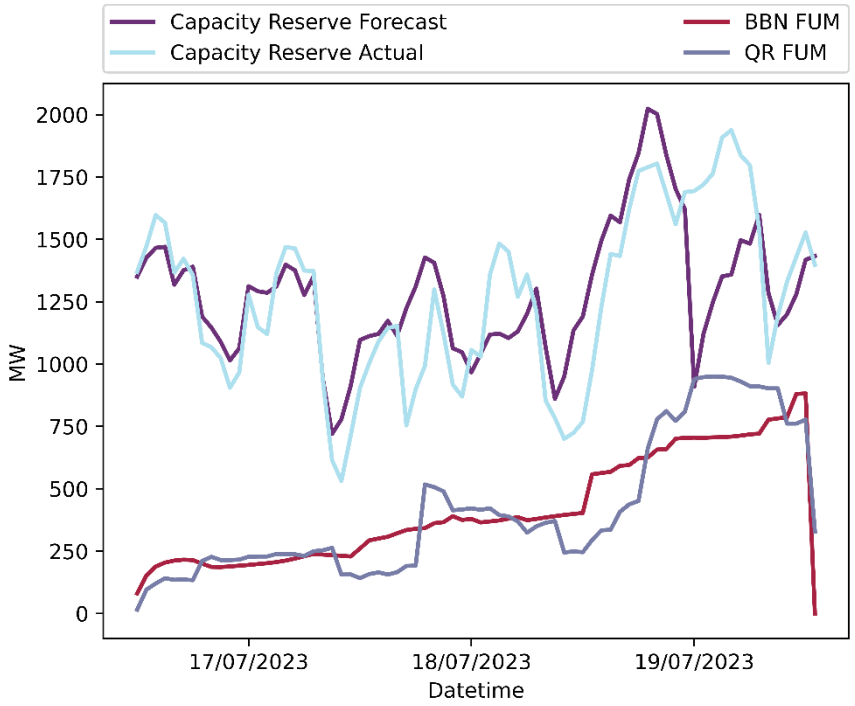


Figure 4 Calculated FUM values from both models against forecast and actual capacity reserves in SA for a single forecast runtime covering 14-17 August 2023.



Conversely, Figure 5 shows the Capacity Reserve Forecast dipping below the QR FUM whilst remaining above the BBN FUM, triggering a period of LOR2 intervals being set by the QR model. This dip occurs only briefly and for a forecast horizon of 54 hours. Since the dip occurs near midday, uncertainty in solar generation likely contributes to the larger value of the QR FUM compared to the BBN FUM.

Figure 5 Calculated FUM values from both models against forecast and actual capacity reserves in SA for a single forecast runtime covering 17-20 July 2023.



There are no impacts to participants as the proposal has no changes to data structures, processes, or systems that participants use.

4. Draft determination

4.1. Draft determination

AEMO has prepared a draft of amendments to the Reserve Level Declaration Guidelines reflecting the proposal, as published with this draft report in mark-up format from the current version (2.1)[6]. AEMO's draft determination is to make version 3.0 of the Reserve Level Declaration Guidelines in that form.

4.2. Effective date

AEMO's proposed effective date for the determination is 22 May 2024.

[6] Found at https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Reserve-Level-Declaration-Guidelines.pdf

Appendix A. Glossary

Term or acronym	Meaning
5MS	Five-Minute Settlement
AEDT	Australian Eastern Daylight Time
AEMO	Australian Energy Market Operator Limited
BBN	Bayesian Belief Network
FUM	Forecast Uncertainty Measure
Guidelines	Reserve Level Declaration Guidelines
LCR	Largest Credible Risk
LOR	Lack of Reserve
ML	Machine Learning
MW	Megawatts
NEO	National Electricity Objective
NEM	National Electricity Market
NER	National Electricity Rules
PV	Photovoltaic
QR	Quantile Regression
RXS	Regional Excess Supply