CHANGES TO RESERVE LEVEL DECLARATION GUIDELINES

ISSUES PAPER

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

EXECUTIVE SUMMARY

The publication of this Issues Paper commences the Rules consultation process conducted by AEMO on proposed changes to the Reserve Level Declaration Guidelines (**Guidelines**) under the National Electricity Rules (NER). This consultation is being conducted in accordance with the special provisions in clause 4.8.4A (e).

AEMO has prepared this Issues Paper to facilitate informed feedback by industry about proposed changes to the determination of the forecast uncertainty measure (FUM), to meet the objectives of the Guidelines more efficiently.

AEMO is investigating several adjustments to the Bayesian Belief Network (BBN) model to improve and develop performance of the reserve level determination process for summer 2018-19 and beyond. Some of those adjustments, relating to the BBN inputs and outputs for the FUM, would need to be reflected in the Guidelines.

The proposed changes can be categorised into two groups as follows:

1. To improve performance for 2018-19
    - Reducing number of models per region.
    - Changing the output bin structure.
    - Changing temperature input bin ranges.
    - Reducing number of output nodes and interpolating in between.
    - To extend the BBN model horizon to cover the 144th trading interval in the horizon

2. To continue development of the process
    - Potential for including additional predictors (if any) into the model.
    - Possible revision of the definition of Regional Excess Supply to take further sources of uncertainty into account
    - Introducing flexibility in determining the frequency of retraining

The first group of proposed changes would not impact upon the intent of the current Guidelines. The scope of these will have limited impact on the Guidelines, with only consequential updates affecting the examples shown in Appendix A.

The second group of proposed changes would require more material changes to the Guidelines and are thus the focus of this Consultation.

AEMO invites stakeholders to suggest alternative options where they do not agree that AEMO's proposals would achieve the objectives and requirements for the Guidelines in NER clause 4.8.4A(b) and (c).

AEMO also asks stakeholders to identify any unintended adverse consequences of the proposed changes.

Stakeholders are invited to submit written responses on the issues and questions identified in this paper by 5.00 pm (Melbourne time) on Wednesday 22 August 2018, in accordance with the Notice of Consultation published with this paper.

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1. STAKEHOLDER CONSULTATION PROCESS

As required by the NER, AEMO is consulting on changes to the Reserve Level Declaration Guidelines in accordance with the amended Rules consultation procedure in rule 4.8.4A (e).

Note that there is a glossary of terms used in this Issues Paper at Appendix A.

AEMO's indicative timeline for this consultation is outlined below. Dates may be adjusted depending on the number and complexity of issues raised in submissions and any meetings with stakeholders.

Deliverable	Indicative date
Issues Paper published	Monday 16 July
Submissions due on Issues Paper	Wednesday 22 August
Update on proposals published	Friday 31 August
Submissions due on updates to proposals	Friday 14 September
Final Report published	Friday 28 September

Prior to the submissions due date, stakeholders can request a meeting with AEMO to discuss the issues and proposed changes raised in this Issues Paper.

2. BACKGROUND

2.1 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 intended 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. 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*);"

The process by which the Guidelines are to be amended is set out in rule 4.8.4A (e). This process is an abridged single stage version of the Rules Consultation procedures set out in rule 8.9.

2.2 Context for this consultation

The initial version of the Guidelines was developed through a consultation process in late 2017 with the initial version being published in December 2017[1].

The new process to determine the reserve levels became operational on 15 February 2018.

AEMO has published a Lack of Reserve Framework Report describing the operation of this new process up to 31 March 2018[2]. This is the first of what will be regular quarterly reports on the performance of the process.

AEMO is considering changes to the process and hence the Guidelines to improve performance of the process for summer 18-19 and to develop the process further.

The details of the proposed changes are set out in Section 3 below.

[1] Refer https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Consultation-on-initial-version-of-Reserve-Level-Declaration-Guidelines

[2] Refer https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Power-system-operation/NEM-Lack-of-Reserve-Framework-Quarterly-Reports

3. PROPOSED CHANGES

This section provides a summary of changes to the design of the FUM determination process (specifically the BBN) which are under consideration. In some cases the full details of the proposed change is not yet available as these details can only be finally determined as part of the development process. Further details will be provided in late August and an opportunity for further comment will be provided at that time.

3.1 Changes proposed to improve performance

Ongoing review of the performance of the system since it has become operational has identified a number of potential changes that would improve its performance. If it becomes necessary to prioritise changes to ensure implementation prior to summer 2018-19, the changes detailed within this group will be prioritised over the proposed changes in Section 3.2. This first group of proposed changes would not impact upon the intent of the current Guidelines. The only changes required to the Guidelines would be consequential updates to the detail of the examples shown in Appendix A.

3.1.1 Reducing number of models per region

Currently, there are nine models per forecast region[3]. An excessive number of models increases the complexity and length of time required for model re-training. Together with the other changes proposed to improve performance, the number of models can potentially be reduced to three models per forecast region, with no adverse impact on forecast accuracy. Each model can be used for the following range of forecasting horizons:

- Model 1 – 0.5 to 24 hours ahead
- Model 2 – 24.5 to 48 hours ahead
- Model 3 - 48.5 to 72 hours ahead

3.1.2 Changing the output bin structure

Experience with the model is that the FUM forecast output bin sizes are too small. This can result in excessive movement in the FUM value for small changes in system conditions. It is thus proposed to increase the output bin sizes to reduce such excessive movement. An increase in the bin sizes could result in fewer but larger movements in the raw FUM values. The impact of any larger movements would be managed through the use of the delta reasonability limits[4].

3.1.3 Changing temperature input bin ranges

AEMO has found through operational experience that the current temperature bin input ranges are inconsistent with the actual point at which extreme temperature conditions begin to arise (typically around 35 º C).

3.1.4 Reducing number of output nodes and interpolating in between

Each model currently has eight FUM output nodes. From observation of FUM and PASA results, FUM values from two adjacent forecast horizons do not vary much. Thus, the number of output nodes can be reduced and an interpolation algorithm can be used to forecast FUM values between two adjacent output nodes.

[3] Each model currently covers an 8 hour period of the forecasting horizon.
[4] Refer document “Revised initial upper reasonability limits” https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Consultation-on-initial-version-of-Reserve-Level-Declaration-Guidelines

3.1.5 To extend the BBN models to cover the 144th trading interval

The BBN models currently cover 143 trading intervals, with a static default starting FUM value selected for the 144th trading interval. The use of a default value for the 144th interval can result in occasions where this value differs from the dynamically calculated value for the 143rd (and prior) interval/s, resulting in a noticeable inflexion in the FUM values at this point in the horizon. To address this issue and use a dynamic updating FUM value for the 144th trading interval, the BBN models will be extended by one additional trading interval.

3.2 Changes proposed to continue development of the process

This second group of proposed changes would require material changes to the Guidelines and are thus the focus of this Consultation.

The changes outlined in Sections 3.2.1 and Section 3.2.2 are being investigated with a view to determining how they can be incorporated into the BBN model to progress further development of the FUM process. As they are not intended to address existing performance issues, these are considered to have a lower priority than the changes proposed in Section 3.1. Thus, implementation of these changes in the BBN may not be achieved by summer 2018-19, and they may only be implemented in part. Nevertheless, some changes can be made to the Guidelines now to facilitate that further development.

The change outlined in Section 3.2.3 is intended to provide for a more flexible and adaptive approach to retraining the BBN.

3.2.1 Including additional predictors into Bayesian Belief Network (BBN) model.

There are potential predictors identified, that can possibly improve the model. These factors include generation by fuel type, weather forecasts from various providers, forecast reserve and weather elements (wind speed and cloud front) ramping. Whether or not these or others will be adopted will not be known until detailed data analysis is completed in August.

It is quite possible that the set of predictors could be required to be adjusted regularly as system conditions change. AEMO thus proposes to specify only a primary set of predictors in the Guidelines and allow flexibility to include or remove secondary predictors using the process already set out in Appendix A.2.1 of the Guidelines. It is also proposed that AEMO would report on any such changes and the reasons for them through the quarterly lack of reserve framework reports.

3.2.2 Revision of definition of Regional Excess Supply

The concept of Regional Excess Supply (RXS) is employed in the BBN process in order to estimate the reserve forecasting uncertainty from the forecasting uncertainty of the various contributing factors. It is used so as to be able to more easily understand which are the more significant contributing factors to reserve forecasting uncertainty.

Currently the components of the RXS value are:

1. available capacity of scheduled generating units (A);
2. unconstrained intermittent generation forecast (B); and
3. Operational Demand (C).

The value of forecast RXS is determined by the formula:

A + B – C.

This definition ensures that forecasting uncertainties of the major factors contributing to the reserve forecast uncertainty are taken into account. These are:

- Forecast availability of scheduled generating units.
- Forecast output of intermittent generation (semi-scheduled and major non-scheduled generating units).
- Forecast system demand including impact of smaller scale embedded generation.

There are other forecasting uncertainties which could, to a lesser extent, impact on the level of reserve forecasting uncertainty. These relate to:

- Network limitations, both inter-regional and intra-regional.
- Supply-demand balance in neighbouring regions.
- Energy limitations on scheduled generating units.

AEMO is considering revisions to the definition of RXS to take these other factors into account in the assessment process for the FUM.

If AEMO's investigations indicate that all of these factors can successfully be incorporated in the BBN, the RXS value would be determined using the following components:

- Aggregate capacity of scheduled generation in the region (C) calculated on the basis of:
  - Aggregate capacity of non-energy limited plant, plus
  - Aggregate capacity of energy limited plant, less
  - Aggregate output of semi-scheduled generating units.
- Interconnector Support (I)
- Aggregate output of semi-scheduled generating units (SS)
- 50 % POE scheduled demand (D)

To include all these components, the RXS formula would be revised to:

$$RXS = C + I + SS - D$$

AEMO proposes that these potential components, if included, would be defined as follows:

Aggregate capacity of non-energy limited plant is the total aggregate contribution to supply from scheduled and semi-scheduled generating units in the region for which no daily energy limit has been specified in ST and PD PASA bids. The value is determined by the PASA process taking into account

- forecast market availability as specified by Generators;
- network limitations as specified by AEMO through network constraint equations; and
- AEMO forecasts for output of semi-scheduled generating units.

This forecast value for each trading interval of each PASA run is reported in the PASA Solution files[5].

Aggregate capacity of energy limited plant is the total aggregate contribution to supply from scheduled generating units in the region for which a daily energy limit has been specified in ST and PD PASA bids. The value is determined by the PASA process taking into account

- forecast market availability as specified by Generators;
- forecast daily energy limit as specified by Generators;
- optimisation of energy limited capacity through the PASA algorithm; and
- network limitations as specified by AEMO through network constraint equations.

This forecast value for each trading interval of each PASA run is reported in the PASA Solution files[5].

[5] This value is expected to be publicly available from September 2018.

Interconnector support is the maximum supply to the region available from adjacent regions after the supply demand balance is satisfied in adjacent regions. This value is determined by the PASA process taking into account:

- network limitations as specified by AEMO through network constraint equations; and
- supply demand balance in adjacent regions as determined by the PASA algorithm.

This forecast value for each trading interval of each PASA run is reported in the PASA Solution files.

Aggregate output of semi-scheduled generating units is the forecast output of semi-scheduled generating units in the region. This value is determined by PASA taking into account:

- unconstrained intermittent generation forecast determined by AEMO forecasting systems; and
- network limitations as specified by AEMO through network constraint equations.

This forecast value for each trading interval of each PASA run is reported in the PASA Solution files.

50 % POE scheduled demand is the expected value of regional electricity demand (excluding scheduled loads) which will need to be met by supply from scheduled and semi-scheduled generating units in the region or from other regions. This value is determined by AEMO forecasting systems taking into account expected

- customer load;
- output of major non-scheduled generating units; and
- output of embedded generating units including rooftop solar generation.

This forecast value for each trading interval of each PASA run is reported in the PASA Solution files.

3.2.3 Flexibility in determining the frequency of retraining

Currently the Guidelines require AEMO to retrain the BBN on a quarterly basis. This means that each retraining will include only an additional three months' worth of data. If there are no major changes in the system conditions, any resulting changes in the FUM will be small. Thus the benefit gained will not always justify the effort required. Accordingly AEMO proposes that the Guidelines be modified to introduce a more flexible approach as follows:

- The BBN would be required to be retrained at least every six months (after Summer and after Winter); and
- AEMO may decide to conduct a further retraining of the BBN at other times if it believes that this is necessary based upon a review of performance and the level of recent changes to the power system.

The quarterly lack of reserve framework reports currently include information on AEMO's retraining activities and, under this proposal, would include the reasons why AEMO decided to retrain or not to retrain the BBN for that quarter. This would ensure that AEMO's decisions in this area are transparent to Participants.

4. DRAFTING FOR PROPOSED CHANGES

The following section provides an indication of the type of changes in the Guidelines that AEMO currently envisages would be required. Full drafting of the proposed Guidelines cannot yet be provided as:

- AEMO expects refinements will be necessary as the development and testing of the BBN adjustments progresses;
- There will be a need to take into account feedback from this consultation as appropriate; and
- It is not clear at this stage when development of some of the improvements proposed in Section 3.2 will be sufficiently advanced to allow their inclusion.

The current guidelines are available on the AEMO website[6]. As indicated in Section 3 above, an update on the proposal will be provided in late August. This will include proposed drafting of changes to the Guidelines.

4.1 Changes proposed to improve performance

For this first group of changes, summarised in Section 3.1 above, the only changes to the Guidelines are expected to be the updating of details in examples in Appendix A of the Guidelines.

4.2 Changes proposed to continue development of the process

4.2.1 Including additional predictors (if any) into Bayesian Belief Network (BBN) model.

Changes to Section 3.2 and Appendix A.2.1 of the Guidelines would be required to implement the proposed changes set out in Section 3.2.1 above.

4.2.2 Possible revision of definition of Regional Excess Supply

This would require changes to the definition of Forecast Regional Excess Supply in Section 3 of the Guidelines as outlined in Section 3.2.2 above and other consequential changes.

4.2.3 Flexibility in determining the frequency of retraining

This would involve changes to Appendix A to describe the process proposed in Section 3.2.3 above.

[6] Refer https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Power-system-operation

APPENDIX A - GLOSSARY

Term or acronym	Meaning
AEMO	Australian Energy Market Operator Limited
Aggregate capacity of non-energy limited plant	Refer Section 3.2.2 of this paper
Aggregate capacity of energy limited plant	Refer Section 3.2.2 of this paper
BBN	Bayesian Belief Network
FUM	Forecast uncertainty measure
Interconnector support	Refer Section 3.2.2 of this paper
MW	Megawatts
MWh	Megawatt hours
NER	National Electricity Rules
PD	Pre-Dispatch
Scheduled Demand	Refer Section 3.2.2 of this paper
RXS	Regional excess supply
RXS error	The expected difference between forecast RXS and actual RXS (see clause 3.2 of the Guidelines)
Aggregate output of semi-scheduled generating units	Refer Section 3.2.2 of this paper
ST	Short - Term