CHANGES TO RESERVE LEVEL DECLARATION GUIDELINES

FINAL REPORT AND DETERMINATION

Published: **November 2018**

EXECUTIVE SUMMARY

The publication of this Final Report and Determination (Final Report) concludes the Rules consultation process conducted by AEMO to change the Reserve Level Declaration Guidelines under the National Electricity Rules (NER).

In July 2018, AEMO published its Issues Paper which provided stakeholders a high-level summary of AEMO's intended changes and the process that AEMO would follow through the consultation process.

AEMO subsequently received two submissions in response to its Issues Paper. These submissions both requested further information and justification for the proposed changes.

In line with AEMO's consultation plan outlined within AEMO's Issues Paper, AEMO subsequently published its Update Paper in October 2018 which provided further information and justification for the proposed changes. A number of changes initially proposed by AEMO within its Issues Paper were withdrawn or modified following consideration of both stakeholder feedback and technical results from AEMO's own further investigations.

AEMO received three submissions in response to the Update Paper, which were all generally supportive of the proposed changes. Further, the submissions made several recommendations which supported continued improvements beyond this consultation.

Based on stakeholder feedback, AEMO has already made improvements to the NEM Lack of Reserve Framework Quarterly Report, published[1] on 31 October 2018.

All submissions have been published on the consultation webpage[2].

In summary, the modifications to the Reserve Level Declaration Guidelines arising from this consultation are expected to improve the Forecast Uncertainty Measure (FUM) through the inclusion of the following:

1. Additional potentially significant components of forecasting uncertainty, which include how the PASA process accounts for:
   − Network limitations, both inter-regional and intra-regional.
   − The supply-demand balance in neighbouring regions.
   − Energy limitations on scheduled generating units.
2. Updates to the inputs that inform the model of expected conditions to:
   − Forecast lead time.
   − Forecast temperature.
   − The current demand forecast error.
   − The forecast of semi-scheduled generation.
   − Forecast solar irradiance.
   − The current scheduled generation fuel mix (coal/gas/hydro).

AEMO's final determination is to amend the Reserve Level Declaration Guidelines in the form published with this Final Report. The expected effective date of the amendments is 6 December 2018, to be confirmed by market notice.

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

[2] Refer http://aemo.com.au/Stakeholder-Consultation/Consultations/Changes-to-Reserve-Level-Declaration-Guidelines.

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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).

The timeline for this consultation is outlined below.

Milestone	Date
Consultation launched and Issues Paper published	Monday 16 July 2018
Submissions due on Issues Paper	Wednesday 22 August 2018
Update on proposals (Update Paper) and draft Reserve Level Declaration Guidelines published	Friday 5 October 2018
Stakeholder forum	Friday 12 October 2018
Submissions due on updates to proposals (Update Paper)	Friday 19 October 2018
Final Report and final Reserve Level Declaration Guidelines published	Wednesday 14 November 2018
Updated Reserve Level Declaration Guidelines become effective	Thursday 6 December 2018 (to be confirmed)

The publication of this Final Report marks the end of this consultation.

A glossary of terms used in this Final Report is at Appendix A.

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[3].

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

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

AEMO has an ongoing obligation (NER rule 4.8.4A) to publish quarterly reports providing analysis of how the Guidelines have been operating to date, and has published three such quarterly reports so far[4].

Since implementation of the Guidelines, AEMO has continued to gain significant operational experience with respect to the methodology, and as a result has identified several areas to improve the performance of the Guidelines.

A summary of the consultation is provided in Section 2.3 below, and a summary of the material issues raised by interested parties is provided in Section 3 below.

2.3. Consultation process

AEMO issued a Notice of First Stage Consultation on 16 July 2018. At this time, AEMO published an Issues Paper[5] which presented the changes it was considering as part of this consultation. The proposed changes were to improve the process for summer 2018-19 and to develop the process further. The Issues Paper noted that AEMO was still progressing the development process to determine whether those changes would proceed, and to establish their full specification. AEMO flagged its intention to publish the outcomes of that process for further comment by stakeholders on the detailed proposals.

AEMO received two written submissions to the Issues Paper, from ERM Power and the Australian Energy Council. Although the Australian Energy Council expressed concern that there was insufficient detail in the Issues Paper, the submissions provided several suggestions and observations that AEMO was able to take into account during the consultation, and other suggestions for review after summer 2018/19.

AEMO published an Update Paper[6] on 5 October 2018 providing further information, analysis, and justification for the proposed changes. Informed by AEMO's further analysis and stakeholder submissions, the Update Paper also identified some proposals from the Issues Paper that would not be progressed or required modification.

AEMO held a stakeholder forum on 12 October 2018 to discuss each of the proposed changes. The forum was attended by representatives from eight registered market participants.

AEMO received three written submissions to the Update Paper, from ERM Power, EnergyAustralia, and Origin Energy.

Copies of all written submissions have been published on AEMO's website at https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Changes-to-Reserve-Level-Declaration-Guidelines?Convenor=AEMO%20NSP.

3. SUMMARY OF MATERIAL ISSUES

The key material issues arising from the proposal and raised by Consulted Persons are summarised in the following table.

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

[5] Refer https://www.aemo.com.au/-/media/Files/Stakeholder_Consultation/Consultations/Electricity_Consultations/2018/RLD/Issues-Paper-Changes-to-RLD-Guidelines-July-18---Final.pdf.

[6] Refer http://aemo.com.au/-/media/Files/Stakeholder_Consultation/Consultations/Electricity_Consultations/2018/RLD/Update-Paper---Changes-to-Reserve-Level-Declaration-Guidelines.pdf

No.	Issue	Raised by
1.	Reducing the number of models per region	AEMO, ERM Power
2.	Changing the output bin structure	AEMO, ERM Power
3.	Changing the temperature input bin structure	AEMO, ERM Power
4.	Reducing the number of output nodes and interpolating in between	AEMO, ERM Power
5.	Extending the BBN models to produce a dynamic FUM value for the 144th trading interval	AEMO, ERM Power
6.	Changing the input predictors used in the BBN models	AEMO, ERM Power, Australian Energy Council, EnergyAustralia
7.	Revision of definition of Regional Excess Supply	AEMO, Australian Energy Council, ERM Power, EnergyAustralia, Origin
8.	Flexibility in determining the frequency of retraining and other matters related to retraining	AEMO, ERM Power, Australian Energy Council
9.	Changes to the confidence level	AEMO, Australian Energy Council, ERM Power, Energy Australia
10.	Reasonability limits	Australian Energy Council, ERM Power
11.	Future reviews of the Guidelines	ERM Power, Origin
12.	Transparency of the reserve requirement	Origin
13.	Lack of Reserve Framework quarterly report	ERM Power
14.	Forecast LORs in the 24 to 72 hr ahead timeframe	ERM Power

A detailed summary of issues raised by Consulted Persons in submissions to both the Issues Paper and the Update Paper, together with AEMO's responses, is in Appendix B.

4. DISCUSSION OF MATERIAL ISSUES

4.1. Reducing the number of models per region

4.1.1. Issue summary and submissions

The current system has nine Bayesian Belief Network (BBN) models per region, each model representing eight hours of the forecast horizon. The output from the nine BBN models is then appended to form a time-series of Forecasting Uncertainty Measure (FUM) values covering the first 72 hours of the forecast horizon.

As each BBN model is trained independently of the other eight BBN models for the given region, there is potential for the FUM values at the end of one BBN model to differ from the FUM values produced at the start of the next BBN model. This is only evident under certain input conditions and is usually only observed for a limited number of runs before the condition is no longer evident.

Reducing the number of models per region from nine to three reduces the number of model boundaries and thus reduces the potential for this issue to occur. To manage the potential differences between FUM values at the remaining two boundary points, the input predictor spacing is adjusted to allow a gradual transition of FUM values from the end of one BBN model to those at the start of the next BBN model.

ERM Power's submission to the Update Paper supported the change to reduce the number of models per region on the basis that the input predictor spacing is also adjusted to allow a gradual transition of FUM values across model boundaries.

4.1.2. AEMO's assessment

AEMO has completed an analysis of this proposed change and performed a backcast to obtain:

- The expected number of LORs for financial year 2017-18; and

- The average, minimum and maximum FUM values for each forecast horizon for quarters 1 and 2 of 2018, compared to the archived values for this period.

The details of the methodology used for the analysis and the results are published in the Update Paper[7].

The results of this analysis demonstrate that the number of models can be reduced from nine per region to three per region, and that the input predictor spacing can be used to manage the potential differences between FUM values at the remaining two boundary points, allowing a gradual transition of FUM values across model boundaries.

These changes will be operated in pre-production for approximately four weeks in parallel with the existing system. During this period, the performance of the upgraded system will be closely monitored. At the end of this period, a full assessment of readiness will be made to determine whether the upgraded system is ready to be deployed into production.

4.1.3. AEMO's conclusion

AEMO will reduce the number of BBN models per region to three models per region and adjust the input predictor spacing to manage the potential differences between FUM values at the remaining two boundary points. The changes will only be deployed after successful operation in pre-production.

This does not require changes to the Guidelines.

4.2.   Changing the output bin structure

4.2.1. Issue summary and submissions

The current output bin structure results in periods where the distribution of Regional excess supply (RXS) error does not have sufficient bins to allow gradations to the FUM value. This is particularly evident under small sample size conditions.

To address this issue, AEMO intends to adjust the output bin structure to allow smaller distributions to capture the small sample size conditions.

AEMO provided additional information in the Update Paper regarding potential output bin sizes and impact on FUM values compared to the current output bin structure. No submissions to the Update Paper commented on this issue.

4.2.2. AEMO's assessment

AEMO has completed an analysis of this proposed change and found that adjustments to the output bin structure prevent instances of "spiky" FUM values due to insufficient bin gradations when small sample size conditions were evident.

The details of the methodology used for the analysis and the results were published in the Update Paper.

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[7] Refer http://aemo.com.au/Stakeholder-Consultation/Consultations/Changes-to-Reserve-Level-Declaration-Guidelines?Convenor=AEMO%20NEM.

4.2.3. AEMO's conclusion

AEMO will adjust the output bin structure to provide additional gradations when small sample size conditions are evident.

This does not require changes to the Guidelines.

4.3. Changing the temperature input bin structure

4.3.1. Issue summary and submissions

The current temperature input bin structure, if applied to the other changes proposed, would result in the forecast temperature input failing to drive material shifts in the distribution of the expected difference between forecast Regional excess supply (RXS) and actual RXS ("RXS error"). This is due to the distribution of forecast temperatures resulting in most of the input values falling into the two lowest bins, and the uppermost bin not capturing the extent of the outer-most tail (which reflects extreme high temperatures). When combined with the increased number of input predictors this results in the temperature input values no longer driving material shifts in the distribution of RXS error.

AEMO initially proposed adjusting the uppermost bin to capture the impact of extreme high temperatures. Based on feedback from ERM Power, AEMO also included a similar change for extreme low temperatures.

In the Update Paper, AEMO proposed to adjust the temperature input bin structure so that the outermost bins capture the tails (1.5%) of the forecast temperature distribution, and thus capture the extent of both extreme low and extreme high temperatures.

ERM Power's submission to the Update Paper requested that additional analysis of this change be provided, indicating why 1.5% bins are optimal compared to alternative bin sizing.

4.3.2. AEMO's assessment

AEMO has completed an analysis of this proposed change and found that changing the temperature input bin structure such that it captures the tails (1.5%) of the forecast temperature distribution is optimal in terms of driving material shifts in the distribution of RXS error. This is based on a sensitivity analysis of the temperature input predictor with varying bin structures ranging from 1% to 5% in steps of 0.5%.

For the upper tail of the distribution, the change to capture 1.5% of the upper tail represents a change of approximately 1 degree Celsius relative to the current temperature input bin structure. For the lower tail of the distribution, the change to capture 1.5% of the lower tail ensures the models capture extreme low temperature uncertainty; with the current temperature input bin structure extreme low temperatures do not drive shifts in the distribution of RXS error.

4.3.3. AEMO's conclusion

AEMO will adjust the temperature input bin structure to ensure the bins capture the tails of the forecast temperature distribution, and the temperature input predictors drives material shifts in the distribution of RXS error.

AEMO will review the operation and performance of the Guidelines after summer 2018-19 to determine if changes to the Guidelines are required, or further improvements can be identified. This review will include assessment of the temperature input bin structure to ensure the bins are optimal.

This does not require changes to the Guidelines.

4.4. Reducing the number of output nodes and interpolating in between

4.4.1. Issue summary and submissions

In the Issues Paper, AEMO raised the potential of reducing the number of output nodes and interpolating the output values between the remaining nodes. This change was initially proposed in conjunction with other proposed changes which would increase the number of data points in each model. At the time of the Issues Paper, AEMO was concerned that the increase in the number of data points would present computational issues and result in challenges with the compilation of the models. Following analysis, the computational issues did not manifest and changes to the number of output nodes and changes to the interpolation between output values is no longer required.

4.4.2. AEMO's assessment

AEMO has completed an analysis of this proposed change and found that reducing the number of output nodes and interpolating output values is not required.

4.4.3. AEMO's conclusion

AEMO will not change the number of output nodes and no interpolation is required.

4.5. Extending the BBN models to produce a dynamic FUM value for the 144th interval

4.5.1. Issue summary and submissions

The current system uses a static default FUM value for the 144th trading interval of each forecast run. This can result in instances where this value differs from the dynamically calculated value for the 143rd (and prior) interval/s, leading to a noticeable inflexion in the FUM values at this point in the forecast horizon. AEMO proposes to extend the BBN models to produce a dynamic FUM value for the 144th trading interval of each forecast run.

ERM Power's submission to the Issues Paper supported this change. There were no further comments on this issue in submissions to the Update Paper.

4.5.2. AEMO's assessment

AEMO considers this change will improve the outcomes of the process when conditions which result in inflexions are evident. AEMO has completed an impact assessment and analysis and expects improved outcomes as a result of implementing this change.

4.5.3. AEMO's conclusion

AEMO will extend the BBN models to produce a dynamic FUM value for the 144th trading interval of each forecast run, replacing the use of the static default FUM value for this interval.

This does not require changes to the Guidelines.

4.6. Changing the input predictors used in the BBN models

4.6.1. Issue summary and submissions

The input predictors inform the model of the expected conditions and are selected to ensure the inputs drive material shifts in the RXS error distribution for different expected conditions. In the Issues Paper, AEMO identified numerous potential input predictors and proposed a primary and secondary set of predictors, with some flexibility to allow AEMO to update the secondary set of predictors.

In the Update Paper, AEMO provided further information on the set of proposed input predictors and the assessment methodology and selection process. This involved a sensitivity analysis to rank the input predictors and determine those which lead to material shifts in the distribution. In the Update Paper, AEMO removed the proposal to include a flexible secondary set of predictors.

Based on this analysis and as set out in the Update Paper, AEMO's revised proposal was to update the selection of input predictors to include:

- Current scheduled demand forecast error;
- Forecast temperature;
- Forecast solar irradiance;
- Forecast semi-scheduled generation;
- Current supply mix by fuel type (coal, gas, hydro).

ERM Power's submission to the Update Paper raised the following concerns about the proposed input predictors:

- Use of scheduled demand forecast error may result in the propagation of a historical error that has been removed by the most recent forecast update.
- Use of scheduled demand forecast error from all trading intervals could lead to overly conservative values compared to periods of increased scrutiny such as periods of low reserve.
- Interval duration of six hours for the semi-scheduled generation, temperature, and solar irradiance inputs may not be optimal.
- AEMO may intend to utilise the temperature forecasts for plant de-rating/trips on extreme days.

ERM Power requested that additional analysis and information be provided in the next review of the Guidelines as to how the current supply mix inputs will be utilised and the benefit provided.

Energy Australia's submission to the Update Paper requested that AEMO consider if the selection of input predictors should be on the basis of those predictors which have the greater impact when Lack of Reserve (LOR) conditions have been present historically.

4.6.2. AEMO's assessment

The sensitivity analysis documented in the Update Paper highlighted the importance of the scheduled demand forecast error in driving the distribution of RXS error in the first six hours of the forecast horizon.

The forecast of demand is updated every 30 minutes by AEMO's Demand Forecasting System – this system uses the most recent measurements of demand when producing the forecast for the periods in the near-term horizon (out to approximately four hours ahead). This results in any current demand forecast errors being corrected in the next demand forecast run. Additionally, the delta raise and delta lower reasonability limits are used to manage any significant FUM value changes due to transient current scheduled demand forecast errors. AEMO considers this will minimise the potential to propagate a historical demand forecast error.

The use of temperature forecasts as input predictors is not intended to forecast plant de-rating or unit trips, but to account for the increased uncertainty of these components when extreme temperatures are present.

With regard to the selection of input predictors based on those which have the greater impact when LOR conditions have been present historically, AEMO considers that adopting this approach to perform the sensitivity analysis will yield insufficient training data.

4.6.3. AEMO's conclusion

AEMO will update the Guidelines to revise the list of input predictors used in the BBN models, as per Section 4.6 of the Update Paper.

During the review of the Guidelines after summer 2018-19, AEMO will review the input predictors and consider if further changes are warranted. This will include analysis of the type of inputs, resolution of inputs and if periods of low reserve should be prioritised.

The following changes will be made to the Guidelines:

- Section 3.2 – the list of input states will be updated.

- Appendix A.1.4 (c) and A.2.1 – will be updated to include the methodology described in the Update Paper.

4.7. Revision of definition of Regional Excess Supply

4.7.1. Issue summary and submissions

The concept of Regional Excess Supply (RXS) is employed in the BBN process to estimate the total reserve forecasting uncertainty from the various factors that contribute to the reserve forecasting process. The current definition of RXS does not capture all the components that contribute to the reserve forecasting process.

In the Issues Paper, AEMO proposed updating the definition of RXS[8] to additionally include:

- Inter-regional and intra-regional network limitations.

- The supply-demand balance in neighbouring regions, and hence the forecast of interconnector support available to a region.

- Energy limitations on scheduled units.

Submissions to the Issues Paper expressed different views on the proposal:

- ERM Power considered the proposed change would result in additional conservative bias in the calculation of reserve levels that was not warranted.

- ERM Power also recommended analysis to consider if the FUM calculation should consider errors from all trading intervals, or only from those intervals where forecasting accuracy is more critical.

- The Australian Energy Council supported expanding the definition of RXS, but questioned the treatment of energy-limited plant as they considered it was not possible to capture all the operational complexities of energy-limited plant in the reserve forecast.

In the Update Paper, AEMO presented the results of the analysis which showed expected FUM values given the revision of the definition of RXS (together with the other changes proposed). The expected FUM values were based on a backcast and compared to archived values from the current system for the same period, as detailed in the Update Paper. The analysis showed that the proposed definition of RXS resulted in generally reduced FUM values, suggesting that the current RXS definition – which does not account for constraints, interconnector support, or energy limited plant – may be overly conservative.

ERM Power's submission to the Update Paper raised concerns regarding the treatment of energy limited scheduled generation, specifically that an energy limited generators maximum availability will align with their reported maximum availability at dispatch and that this may not be captured accurately in the projected assessment of system adequacy (PASA) processes. ERM Power also reserved its support for

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[8] AEMO proposes to update the definition of RXS for all mainland NEM regions; for the Tasmanian region AEMO proposes to retain the current RXS definition, for reasons as outlined in the Update Paper.

"positive gatekeeper units" (where increased generation output from that particular generator increases interconnector support) until AEMO provides additional analysis and detail supporting the use and benefits of this change in the next review of the Guidelines.

Energy Australia's submission to the Update Paper recognised the improvements AEMO has made to the PASA process and how energy limited plant capacity is allocated, but suggested further improvements could be made to ensure the results reflect likely actual outcomes in the market. Energy Australia also requested that AEMO publish all outcomes of the PASA process to allow participants to examine the energy limited plant allocations. Energy Australia requested AEMO "provide more clarity around how they dispatch (and in what merit order) generators and the amount imported across interconnectors when determining the remaining allocation to energy limited plant". Energy Australia also queried the cause of the step change in the "CON_GEN_ERROR" component for South Australia published in Appendix B of the Update Paper, beginning around mid-2016.

Energy Australia's submission requested further information to explain why the definition of scheduled demand includes the output of non-scheduled generating units. Energy Australia suggested it would be "beneficial to separate the non-scheduled generating units from the embedded generation (for example, rooftop solar)" to allow the forecast errors to be understood by participants and AEMO. Energy Australia also proposed, for similar reasons, to include non-scheduled and semi-scheduled generation and to split semi-scheduled wind and solar generation. Energy Australia also suggested splitting each of the main fuel types (coal/gas/hydro) to provide insight into the major contributors to forecast error.

Origin's submission to the Update Paper suggested AEMO "consider that energy constrained plants are modelled as using their fuel reserves at the time of day where maximum demand is forecasted".

4.7.2. AEMO's assessment

AEMO considers that forecasting accuracy is critical during all trading intervals, and that the FUM calculation should continue to consider all trading intervals.

The proposed changes in relation to energy limited plant assess the forecast and actual values of this component as determined by the PASA process. The results of the PASA process are then used to determine reserve levels and LOR conditions. The PASA process determines the *aggregate capacity of energy limited plant* considering:

- Forecast market availability as specified by Generators.
- Forecast daily energy limit as specified by Generators.
- Optimisation of energy limited capacity through the PASA algorithm.
- Network limitations as specified by AEMO through network constraint equations.

Thus the proposed change to the definition of RXS to incorporate the component of *aggregate capacity of energy limited plant* is not only to consider the uncertainty in relation to the operation of this component, but more importantly to account for the uncertainty in how the PASA process determines the value of this component.

AEMO has recently made a number of improvements to how the PASA process allocates the capacity of energy limited plant[9] and recognises the need for further optimisations with regard to energy limited plant to address stakeholder concerns. AEMO considers these changes fall under the scope of a review of the PASA process and intends to address these changes in a PASA review project scheduled for mid-2019.

The PASA solution files published on AEMO's website and through the EMMS Data Model contain each of the components of the revised RXS definition. The PASA region solution includes the

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[9] These improvements were presented to stakeholders at the NEM Wholesale Consultative Forum in June 2018 and became effective on 11 July 2018.

"CONSTRAINEDCAPACITY" field which is the *aggregate capacity of energy limited plant* as determined by the PASA process.

AEMO has assessed the South Australian energy limited plant error component and found that the step-change in this component from approximately mid-2016 is due to the bidding of Torrens Island generating units to include a daily energy limit from this date. This resulted in a shift of uncertainty from the non-energy limited plant error component to the energy limited plant component from approximately mid-2016.

The forecast value of the *scheduled demand* component of the proposed RXS definition is calculated using forecasts of the output of non-scheduled generating units and the output from rooftop solar generation. This is because non-scheduled and rooftop solar generation are significant generation sources that have the effect of reducing *scheduled demand* when they are at high levels. Not accounting for them when producing the forecast of *scheduled demand* could lead to significant errors in the load forecast model.

The forecasts of output from non-scheduled generating units and rooftop solar generation are produced by AEMO's wind and solar forecasting systems and are subtracted from the forecast of demand to produce the forecast *scheduled demand*; the output of non-scheduled generation and rooftop solar is not included in the *scheduled demand* but is used in the model to produce the forecast of demand. As the non-scheduled component is already being used to produce the demand forecast, AEMO considers separating the non-scheduled component is unnecessary because the associated uncertainty is already reflected in the *scheduled demand* component.

4.7.3. AEMO's conclusion

AEMO will revise the definition of Regional Excess Supply as outlined in Section 4.7 of the Update Paper.

AEMO will investigate further optimisations to the ST and PDPASA process allocation of capacity from energy limited plant as part of the PASA review project scheduled for mid-2019.

AEMO will review the operation and performance of the Guidelines after summer 2018-19 and determine if changes to the Guidelines are required, or further improvements can be identified. This review will include assessment of further increases to the granularity of the forecast generation components of RXS and if such changes are warranted.

The revised definition of RXS will require changes to the following sections of the Guidelines:

- Section 3.1 – to update the components of the RXS definition, provide for a separate definition for Tasmania and explain the difference.

- Appendix A Section A.1 – to update the sources of error and add subsections to describe each source.

4.8. Flexibility in determining the frequency of retraining and other matters related to retraining

4.8.1. Issue summary and submissions

In the Issues Paper, AEMO proposed to introduce flexibility in the retraining of the BBN models, such that the models would be retrained at a minimum of once every six months, with additional retraining on an as-needs basis as determined by AEMO.

Submissions on the Issues Paper expressed concerns about this proposal and the adequacy of the retraining process, also suggesting the process should analyse the number of forecast versus actual LOR notices to provide an indication of the number of false positives.

AEMO continued working to streamline the model retraining process by automating, as much as possible, the data extraction, model creation and retraining, and model verification steps. The changes proposed to

reduce the number of models per region further simplified the retraining and verification procedure. Due to the efficiencies achieved through implementing these changes, AEMO indicated in the Update Paper that it no longer proposes to introduce a flexible retraining schedule and will continue to retrain the BBN models on a quarterly basis.

No submissions to the Update Paper commented on this issue.

4.8.2. AEMO's assessment

AEMO has reviewed the BBN model retraining process and concluded that it does not require flexibility in determining the frequency of retraining.

In relation to the concerns initially expressed by the Australian Energy Council on the retraining process, AEMO notes that the deployment of retrained BBN models is subject to a number of verification checks. A week-long functional soak test in pre-production is just one component of those checks. AEMO has recently developed (as part of the analysis completed for this consultation) backcast functionality to determine approximate FUM values for historic periods, given the input conditions as at that time. This functionality was used to prepare the analysis for this consultation and will be used in future to compare the number of forecast LOR notices against historic forecast and actual LOR notices.

4.8.3. AEMO's conclusion

AEMO will continue to retrain the BBN models on a quarterly basis, and will incorporate the use of the backcast functionality when analysing and reporting on BBN model retraining.

4.9. Changes to the confidence level

4.9.1. Issue summary and submissions

The Australian Energy Council's submission to the Issues Paper recommended AEMO reconsider whether the initial confidence levels remain appropriate. The Australian Energy Council suggested two methods for analysing the confidence levels:

- The first method involved analysis of the number of forecast to actual LORs.
- The second method included an assessment of actual costs of intervention balanced against the economic benefit of avoided load interruption.

In the Update Paper, AEMO proposed revising the confidence level to 95% for the full forecast horizon.

ERM Power's submission to the Update Paper recommended AEMO consider if the confidence levels can be scaled progressively from 95% to 90% in the forecast horizon for 24 to 72 hours ahead.

Energy Australia's submission to the Update Paper urged AEMO to continue to be transparent on the selection of confidence levels.

4.9.2. AEMO's assessment

In the Update Paper, AEMO completed an analysis of the confidence level and proposed the change to 95% based on the need to strike a balance between reducing the chance of LOR load shedding and increasing the likelihood of unnecessary LOR declarations, as set out in the Guidelines. AEMO considers both methodologies proposed by the Australian Energy Council to assess the confidence levels are well reasoned, however is of the view that further historical data may be required before either of them could be implemented with confidence.

4.9.3. AEMO's conclusion

As set out in the Guidelines, AEMO is required to review the confidence levels at least annually, and is committed to review and (if appropriate) amend the levels in a transparent manner.

AEMO will next review the confidence levels during the broad review of the Guidelines after summer 2018-19. At this time, AEMO will consider if each of the Australian Energy Council's methodologies can be implemented, and if the 95% level is appropriate (or if progressive scaling to 90% is required, as suggested by ERM Power).

AEMO will update the confidence level to 95% for the full forecast horizon for all regions.

This requires changes to Appendix B of the Guidelines.

4.10. Reasonability limits

4.10.1. Issue summary and submissions

The Australian Energy Council's submission to the Issues Paper noted that the reasonability limits are an important safety net feature of the tool and requested they be contained within the Guidelines. The submission also requested analysis of how often the reasonability limits have bound the FUM to date.

ERM Power's submissions to the Issues Paper and the Update Paper commented that the upper reasonability limit values are set at very high levels, and recommended that AEMO consider additional consultation on the Guidelines following the summer of 2018-19. ERM Power suggested that analysis be undertaken following the summer of 2018-19 on the level of the upper reasonability limit values with regards to their ongoing effectiveness and suitability.

4.10.2. AEMO's assessment

AEMO has completed an analysis of how often the reasonability limits have bound to date and found that the upper and lower reasonability limits have bound on average for less than 1% of intervals. The delta raise and delta lower reasonability limits have bound on average for less than 13% of intervals. AEMO considers the relatively higher rate of binding of the delta reasonability limits is to be expected, because these limits are designed to manage the rate of change of the FUM value between successive runs, to ensure the results can be used for operational decision making.

4.10.3. AEMO's conclusion

AEMO will include the reasonability limits in the Guidelines.

AEMO will review the operation and performance of the Guidelines after summer 2018-19 and determine if changes to the Guidelines are required, or further improvements can be identified. This review will include assessment of the appropriateness of the reasonability limits.

The inclusion of the reasonability limits will require the following changes to the Guidelines:

- Section 3.5 – the description of the reasonability limits will be updated.
- Appendix – an appendix with the values of the reasonability limits will be added.

4.11. Future reviews of the Guidelines

4.11.1. Issue summary and submissions

ERM Power's submission to the Update Paper supported ongoing regular review of both the inputs to the calculation methodology and the process. Origin's submission to the Update Paper strongly supported

assessment of the Guidelines and implementation of learnings since its operation before summer 2018-19. Origin also suggested AEMO conduct a review of the Guidelines following summer 2018-19.

4.11.2. AEMO's assessment

AEMO is required to review and report on the operation and performance of the Guidelines in the Lack of Reserve Framework quarterly reports.

4.11.3. AEMO's conclusion

Following implementation of the changes as documented in this report, AEMO will review the operation and performance of the Guidelines after summer 2018-19 and determine if changes to the Guidelines are required, or further improvements can be identified. If changes are required or further improvements are identified, AEMO will initiate a consultation to update the Guidelines in mid-2019.

4.12. Transparency of the reserve requirement

4.12.1. Issue summary and submissions

Origin's submission to the Update Paper requested provision of more transparent information on whether declaration of an LOR condition is due to the reserve requirement being set by the FUM or by the largest credible risk/s. Origin indicated that this information could provide guidance on the appropriate response by market participants, and build confidence and understanding of the model.

4.12.2. AEMO's assessment

AEMO will publish the value of the FUM, the largest credible risk, and the two largest credible risks for each region and forecast timestep from every pre-dispatch (PD) PASA and short-term (ST) PASA run in the respective Region Solution tables. These values can be compared to the (already published) reserve requirement to determine which component is setting the requirement. These values will be published in the solution files available on AEMO's website, and through the EMMS Data Model. The implementation date to publish these values is documented in the EMMS release schedule available on AEMO's website[10].

4.12.3. AEMO's conclusion

AEMO considers that the publication of the value of the FUM, the largest credible risk, and the two largest credible risks will address Origin's suggestion and provide the transparency required to determine what is setting the reserve requirement.

AEMO has implemented changes to the Lack of Reserve Framework quarterly report to improve transparency of whether the reserve requirement is being set by the FUM or the largest credible risk(s).

AEMO will consider publishing the specific parameters setting the level of the largest credible risk and two largest credible risks as part of the PASA review project scheduled for mid-2019.

4.13. Lack of Reserve Framework quarterly report

4.13.1. Issue summary and submissions

ERM Power's submission to the Issues Paper suggested changes to the Lack of Reserve Framework quarterly report published by AEMO. The suggestions were intended to improve transparency of whether the reserve requirement is being set by the FUM or the largest credible risk(s), provide additional

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[10] Refer http://aemo.com.au/-/media/Files/Electricity/NEM/IT-Systems-and-Change/2018/EMMS-Release-Schedule-and-Technical-Specification--Dec-2018--Data-Model-v428.pdf.

commentary when changed conditions result in updates or cancellation of LOR conditions, and layout changes to facilitate the interpretation of the data presented in the report.

AEMO informed stakeholders at the stakeholder forum of the intention to update the quarterly report to address feedback received.

ERM Power's submission to the Update Paper supported AEMO's intended changes to the quarterly report.

4.13.2. AEMO's assessment

AEMO agrees that ERM Power's suggested changes to the Lack of Reserve Framework quarterly report will improve the transparency and interpretation of the framework.

4.13.3. AEMO's conclusion

AEMO has already implemented these changes in the Lack of Reserve Framework quarterly report for the July to September 2018 quarter. AEMO welcomes further feedback on the structure and information presented in the report.

4.14. Forecast LORs in the 24 to 72 hours ahead timeframe

4.14.1. Issue summary and submissions

ERM Power's submission to the Issues Paper raised concerns around a perceived increase in the number of forecast LORs following implementation of the Guidelines, which ERM Power assumed were caused by large FUM values in the 24 to 72 hours ahead timeframe.

4.14.2. AEMO's assessment

AEMO has included further detail in the Lack of Reserve Framework quarterly report to clarify whether the reserve requirement was being set by the FUM or the largest credible risk(s) at the time of each LOR declaration.

AEMO published analysis in the Update Paper which indicated the changes proposed in this consultation were generally expected to reduce the minimum, average, and maximum FUM values.

4.14.3. AEMO's conclusion

AEMO considers that the changes described in this report will result in a reduction in expected FUM values. The quarterly report changes will provide greater clarity and improve transparency on trends in the frequency of LOR declarations.

5.   OTHER MATTERS

5.1.   FUM values and the LOR assessment horizon

5.1.1.   Issue summary and submissions

The Guidelines define the LOR assessment horizon as the period from the current time to the end of the period covered by the most recently *published short term PASA*. In sections 3.3 and 3.6 of the Guidelines it describes how the FUM is determined using the RXS error for the first 72 hours of the LOR assessment horizon, and the FUM value is set to zero for the remainder of the assessment horizon.

In discussion during the stakeholder forum there was confusion among participants with respect to the use of FUM values beyond 72 hours ahead, and it was not clear that beyond this horizon and for the remainder of the assessment period the FUM value is not setting the reserve requirement.

5.1.2. AEMO's assessment

AEMO has reviewed the Guidelines and considers that the explanation of what sets the reserve requirement beyond 72 hours ahead could be made clearer.

5.1.3. AEMO's conclusion

AEMO will update the following sections of the Guidelines to clarify that beyond 72 hours ahead the FUM value is set to zero and the reserve requirement is set by the largest credible risk(s):

- Figure 1 – to show the FUM value being set to 0 beyond 72 hours ahead.
- Section 3.3 – to clarify that the BBN models extend for the first 72 hours of the forecast horizon and beyond this point the FUM value is set to 0.
- Removal of section 3.6.

6. FINAL DETERMINATION AND EFFECTIVE DATE

Having considered the matters raised in submissions, AEMO's determination is to amend the Reserve Level Declaration Guidelines in the form published with this Final Report, in accordance with clause 4.8.4A(e) of the NER.

AEMO intends to make the amended version of the Guidelines effective on 6 December 2018. AEMO will issue a market notice to inform participants of the effective date once it has been confirmed. AEMO will issue an additional market notice when the system implementation is effective.

APPENDIX A. GLOSSARY

Term or acronym	Meaning
AEMO	Australian Energy Market Operator Limited.
Aggregate capacity of energy limited plant	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 and considers: forecast available capacity 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 through network constraint equations.
Aggregate capacity of non-energy limited plant	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 and considers: forecast available capacity specified by Generators; network limitations as specified through network constraint equations; and forecasts for output of semi-scheduled generating units.
Aggregate output of semi-scheduled generating units	The forecast output of semi-scheduled generating units in the region. The value is determined by the PASA process and considers: unconstrained intermittent generation forecast determined by AEMO; and network limitations as specified through network constraint equations.
BBN	Bayesian Belief Network
FUM	Forecast uncertainty measure
Interconnector support	The maximum supply to the region available from adjacent regions after the supply demand balance is satisfied in adjacent regions. The value is determined by the PASA process and considers: network limitations as specified through network constraint equations; and supply demand balance in adjacent regions as determined by the PASA algorithm.
MW	Megawatts
MWh	Megawatt hours
NER	National Electricity Rules
PASA	Projected Assessment of System Adequacy
PD	Pre-Dispatch
Scheduled Demand	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. The value is determined by AEMO forecasting systems and considers: customer load; output of major non-scheduled generating units; and output of embedded generating units including rooftop solar generation.
RXS	Regional excess supply
RXS error	The expected difference between forecast RXS and actual RXS (see clause 3.2 of the Guidelines)
ST	Short term

APPENDIX B.   SUMMARY OF SUBMISSIONS AND AEMO RESPONSES

Submissions to the Issues Paper

No.	Consulted person	Issue	AEMO response
1.	ERM Power	**Increase in LOR declarations in the 24 to 72 hour timeframe** "We are concerned by the increase in number of Lack of Reserve (LOR) declarations by AEMO following the implementation of the FUM into AEMO's reserve level declaration process where the cause can be directly attributed to large FUM values in the 24 to 72 hour timeframe … We believe this is leading to additional and unnecessary LOR declarations to the detriment of efficient operation of the National Electricity Market (NEM) through the increased prospect for market intervention."	AEMO considers that the proposed changes described in this report will result in a reduction in expected FUM values. Together with the changes to the Lack of Reserve Framework quarterly report, this should address ERM Power's concern.
2.	ERM Power	**Reducing the number of models per region** "Provided thorough testing is undertaken to ensure accuracy is retained or improved we would support this change."	The upgraded system will be operated in pre-production for four weeks in parallel with the existing system. During this period the performance of the upgraded system will be closely monitored. At the end of this period a full assessment of readiness will be made to determine whether the upgraded system is ready to go into production.
3.	ERM Power	**Changing the output bin structure** "We request that AEMO provide additional information in the Draft Determination regarding a potential range of output bin sizes and the potential impact on FUM values compared to the current output bin structure and FUM value changes. Absent this analysis we are unable to properly consider the proposed change."	AEMO provided further information regarding the output bin structure in the Update Paper.
4.	ERM Power	**Changing the temperature input bin ranges** "We have no concerns with AEMO's proposed change with regards to Summer temperature conditions. We also recommend AEMO consider if a similar change is warranted for Winter conditions following the completion of the Winter 2018 period."	AEMO provided further information regarding the temperature input bin ranges in the Update Paper, including addressing the extreme low temperature conditions.
5.	ERM Power	**Reducing number of output nodes and interpolating in between** "Provided thorough testing is undertaken to ensure accuracy is retained or improved we support this change."	AEMO has withdrawn the proposal to reduce the number of output nodes and interpolate values due to this no longer being required.

6.	ERM Power	To extend the BBN models to cover the 144th trading interval "We support the proposed change."	Noted.
7.	ERM Power	Including additional predictors into the Bayesian Belief Network (BBN) model "We request that AEMO provide additional information in the Draft Determination regarding this proposed change following completion of the analysis indicated in the Issues Paper. Absent this analysis we are unable to properly consider the proposed change"	AEMO provided further information regarding the additional predictors in the Update Paper.
8.	ERM Power	Revision of definition of Regional Excess Supply "ERM Power has concerns that this proposed change will result in an additional conservative bias in the calculation of reserve levels. ... We do not believe this extra level of conservative bias in the calculation of reserve levels is required or in fact warranted."	AEMO provided further information in the Update Paper which showed the proposed change to the definition of RXS would result in an expected reduction in FUM values.
9.	ERM Power	Flexibility in determining the frequency of retraining "ERM Power believes it is premature to support AEMO's proposed change and would strongly prefer that model retraining continue at 3 monthly intervals until at least June 2020." "We acknowledge that AEMO has commenced improvement projects with regards to AEMO's forecasting processes; however, improvements in this area will require time to flow through to the FUM calculation models and we believe it is important that any improvements are captured in a timely manner. ... AEMO should consider if the application of weightings in the modelling process is warranted to give greater weighting to periods where improvements in AEMO's forecasting processes have been observed."	AEMO will continue to retrain the BBN models at 3 monthly intervals. Increased automation and reduction in number of models per region have reduced the need for flexibility in timing of retraining.
10.	ERM Power	FUM Calculation "ERM Power remains concerned by an apparent continued conservative bias towards over-forecasting during higher forecast demand periods. Whilst in theory this positive error will eventually flow through to the FUM calculation process, these high demand periods are of only two to four hours duration in any given day and as such, under-forecasting errors in less critical demand periods may swamp the over-forecasting bias in higher demand periods in the FUM calculation methodology. We recommend AEMO conduct analysis to consider if the FUM calculation should continue based on errors from all Trading Intervals or if the error inputs should be confined only to those Trading Intervals in any day where forecasting accuracy is more critical."	AEMO considers all intervals critical for the purposes of training the BBN models to ensure the trained models have data covering all types of conditions.

11.	ERM Power	**Reasonability Limit Values and the Confidence Values** "In the current consultation process both the Reasonability Limit Values and the Confidence Levels Values were not considered. Both the values are currently set at very high levels. We recommend that AEMO consider additional consultation on the Guidelines following the summer of 2018-19, and that analysis be undertaken on these values with regards to their ongoing effectiveness and suitability given their potential to result in additional costs to consumers."	AEMO will review the operation and performance of the Guidelines after summer 2018-19 and determine if changes to the Guidelines are required, or further improvements can be identified. This review will include assessment of the appropriateness of the reasonability limits and confidence levels.
12.	ERM Power	**AEMO's NEM Lack of Reserve Framework Report** ERM Power suggested improvements: • "Separation of the identified Actual LOR2, Actual LOR1, Forecast LOR2 and Forecast LOR1 notifications into four separate tables" • "Inclusion of the FUM and minimum reserve level values in the tables" • "Improvements in the comments areas regarding the cause of updates to forecast or actual LOR conditions and reasons where LOR conditions are cancelled"	AEMO implemented the suggested changes in the Lack of Reserve Framework quarterly report for the July to September quarter. AEMO welcomes further feedback on the structure and information presented in the report.
13.	Australian Energy Council	**Including additional predictors into the Bayesian Belief Network (BBN) model** "As the Guidelines stand, Appendix A.2.1 "Sensitivity Analysis" discusses tests AEMO conducted to assess the impact of input nodes, but by the Energy Council's reading this does not grant AEMO the latitude to incorporate additional inputs in the model's calculations without consultation with stakeholders."	As outlined in the Update Paper, AEMO will specify additional input predictors and it is no longer necessary to incorporate this flexibility into the Guidelines.
14.	Australian Energy Council	**Revision of definition of Regional Excess Supply** "The Energy Council supports the expansion of the definition, but questions the treatment of energy-limited plant, as it is not possible to capture all the operational complexities of energy-limited plant in an LoR2 forecast. The Energy Council submits that owners of energy-limited plant are likely to retain some energy in order to be able to quickly dispatch capacity should a deterioration in conditions occur, therefore AEMO's proposal may not incorporate energy-limited plant into its forecasts adequately."	AEMO will investigate further optimisations to the PASA process allocation of capacity from energy limited plant as part of the PASA review project scheduled for mid-2019.

15.	Australian Energy Council	**Reasonability Limit Values and the Confidence Values** "The Issues Paper doesn't reconsider whether the initial confidence levels remain appropriate. The confidence level is the key judgemental parameter that balances reliability against the cost of intervention. To exercise this judgement, it is important that as much history as possible is analysed to assess whether the confidence level (and other parameters) have been optimally set." "Historical data should be analysed to test whether: • the number of observed false positive and negative forecasts matches what is expected by the initial confidence levels. For example, as the forecasting horizon of 21.5 to 72 hours has a confidence interval of 95%, the Energy Council would expect that no less than 1 in 20 forecast LoR2s would result in an actual LoR3. • the confidence levels themselves are appropriate. For example, this would include an assessment of the actual costs of intervention events resulting from LoR2 declarations. This could be balanced against the economic benefit of avoided load interruption (as expressed in AEMO's Value of Customer Reliability) multiplied by the probability of its occurrence as expressed in the confidence interval. " "These [reasonability] limits have become an important safety net feature of the tool and therefore should be contained within the Guidelines, and their appropriate levels discussed in the Issues Paper. The paper should include analysis of how much they have bound the FUM to date, and if not, the maximum FUM values to date."	AEMO will review the operation and performance of the Guidelines after summer 2018-19 and determine if changes to the Guidelines are required, or further improvements can be identified. This review will include assessment of the appropriateness of the reasonability limits and confidence levels (including review of the methodology used to assess the confidence levels).
16.	Australian Energy Council	**Scope of consultation, detail of proposed changes, and justification of changes** "the Energy Council envisaged that there would be a broader scope, and more detail of the proposed changes and their rationale than the four pages set out in the Issues Paper." "The Energy Council also has concerns about the inadequate justification for the changes proposed to the Guidelines. For example, the Guidelines state that the number of models can be reduced from nine to three per forecast region, 'with no adverse impact on forecast accuracy'. The Issues Paper and supporting documentation offers no evidence for this assertion." "the Energy Council believes the abbreviated Issues Paper and its supporting documentation is wholly inadequate for industry to properly assess AEMO's planned changes to the Guidelines. It is important for system reliability and stakeholder contentment for the coming summer that significantly more detail is provided, and draft Guidelines released before their implementation."	AEMO provided further information to address these concerns in the Update Paper and Stakeholder forum.

| 17. | Australian Energy Council | **Testing Period Adequacy**
"The Energy Council also finds that testing the retraining by using only a week for comparison, as was set out in the Retraining Report, is inadequate." | The deployment of the retrained BBN is subject to the following Quality Assurance (QA) and verification checks:
• Comparison of error distributions for the retrained BBN against the existing BBN, which accounts for all historic data included in the training set.
• A sensitivity analysis to compare error distribution changes when input predictors are specified. This compares how the distributions change in the retrained BBN against the existing BBN.
• A week-long functional soak test in pre-production to perform an acceptance test to verify that the retrained model can be deployed into the production system, and to give an estimate of the difference in FUM values when comparing the retrained BBN against the existing BBN.
The retrained BBN must pass each of these tests before being rolled-out to production. |
| 18. | Australian Energy Council | **Retraining Report Improvements**
"The Retraining Report should analyse the number of forecast LoR2 notices versus the actual number of LoR2 notices over a longer period, to provide an indication of the number of false positives." | AEMO implemented changes to identify the ratio of forecast and actual LOR notices in the Lack of Reserve Framework quarterly report for the July to September 2018 quarter. AEMO welcomes further feedback on the structure and information presented in the report. |

Submissions to the Update Paper

No.	Consulted person	Issue	AEMO response
1.	ERM Power	**Reducing number of models per region** "We support the change which reduces the potential for discontinuity of FUM values between model boundaries on the basis that AEMO will also introduce a complementary change to the input predictor spacings within the models to allow a gradual transition in FUM values in the boundary areas of the three proposed models."	AEMO will reduce the number of models per region and will optimise the input predictor spacing.
2.	ERM Power	**Proposed change to the temperature input bin structure** "We ask that additional analysis regarding the outcome of this significant change be provided in the next review of the Guideline... additional analysis should be provided to clearly indicate that the 1.5% bin sizing of the distribution of temperatures for the first and third bins is optimal compared to alternative bin sizing."	AEMO has provided further information in this Final Report on how AEMO determined that the 1.5% bin sizing was optimal compared to alternative bin sizing. AEMO will review the operation and performance of the Guidelines after summer 2018-19 and determine if changes to the Guidelines are required, or further improvements can be identified. This review will include assessment of the temperature input bin structure to ensure the bins are optimal.
3.	ERM Power	**Input predictors - Scheduled demand forecast error** ERM Power are concerned that "this may result in the propagation of a historical error that has been removed by the most recent AEMO scheduled demand forecast update into the FUM calculation for the next twelve Trading Intervals." ERM Power "remain concerned by the "bundling" of demand forecasting error from periods in the day in which the demand forecast error may be less relevant and therefore subject to a lower level of scrutiny compared to periods which are subject to increased scrutiny due to the impact of forecast reserve conditions." ERM Power "recommend AEMO conduct further analysis to consider if the FUM calculation should continue based on errors from all Trading Intervals or if the error inputs should be confined only to those Trading Intervals in any day where forecasting accuracy is more critical which may result in increased scrutiny of the forecast outcomes."	The scheduled demand forecast is updated every 30 minutes and uses the most recent measurements of demand when producing the forecast for the near-term horizon (out to approximately four hours ahead). This results in any current demand forecast errors being corrected in the next demand forecast run. Additionally, the delta raise and delta lower reasonability limits are used to manage any significant FUM value changes due to transient current scheduled demand forecast errors. AEMO considers that forecasting accuracy is critical during all trading intervals as evidenced by recent instances of forecast LORs being declared outside of the evening peak period due to the late return from planned network outages that reduced supply. Therefore, AEMO considers that the FUM calculation should continue to consider all trading intervals.

4.	ERM Power	**Input predictors - Semi-scheduled generation, temperature and solar radiation forecast inputs at 6-hourly intervals** ERM Power are "concerned that an interval duration of six hours may not represent the optimal forecast duration interval to allow an accurate calculation of FUM values. We ask that AEMO provide additional analysis to justify why AEMO consider forecasts of these input predictors at a six-hour interval to be the optimal forecast interval in the next review of the Guideline." ERM Power are "concerned that the Paper indicates that AEMO intends to utilise the temperature forecasts for plant de-rating/trips on extreme days... and do not support AEMO's intention to use forecast temperature outcomes as a possible determinant for the probability of a unit trip occurring until such time that AEMO produces analysis to support the assertion that the probability of a unit trip occurring increases with temperature outcomes."	During the review of the Guidelines after summer 2018-19 AEMO will review the input predictors and consider if further changes are warranted. This will include analysis of the type of inputs, resolution of inputs and if periods of low reserve should be prioritised. The use of temperature forecasts as input predictors are not intended to forecast plant de-rating or unit trips, but to account for the increased uncertainty of these components when extreme temperatures are present.
5.	ERM Power	**Input predictors - Current fuel mix** ERM Power: "the Update Paper fails to provide any information as to how the inputs will be utilised or the benefits this provides. We ask that additional analysis and information supporting the use and benefits of the values be provided in the next review of the Guideline."	During the review of the Guidelines after summer 2018-19 AEMO will review the input predictors and consider if further changes are warranted. This will include analysis of the type of inputs, resolution of inputs and if periods of low reserve should be prioritised.
6.	ERM Power	**Revision of definition of RXS** ERM Power have "significant concerns regarding the proposed change in the calculation of Regional Excess Supply (RXS) due to energy limited scheduled generation... fails to recognise that whilst energy may potentially be subject to a nominal limit across a Trading Day, the Maximum Availability able to support the reliable supply of electricity to consumers in any individual Trading Interval will align with a generator's reported Maximum Availability at Dispatch..." ERM Power "reserve support for the use of AEMO's Trading Interval based energy limited generation availability allocation or the Bid Maximum Availability values where a generator acts as a positive gatekeeper (where increased generation output from that particular generator increases network limits) until additional analysis and detail supporting the use and benefits of this change is provided in the next review of the Guideline."	AEMO will investigate further optimisations to the PASA process allocation of capacity from energy limited plant as part of the PASA review project scheduled for mid-2019.

7.	ERM Power	**Revision of the confidence levels** "For the next review we urge AEMO to consider if similar to the existing Guideline, the confidence levels can be scaled progressively from the single 95% value to 90% in the forecast horizon of 24 to 72 hours."	AEMO will next review the confidence levels during the broad review of the Guidelines after summer 2018-19.
8.	ERM Power	**Lack of Reserve Framework quarterly report** "Whilst not forming part of this consultation, we understand that AEMO has considered the comments we provided in our submission to the original Issues Paper regarding the format of the quarterly reports. We thank AEMO for their consideration in reviewing the report format and look forward to issue of the next report in the suggested revised format in late October 2018."	Noted.
9.	ERM Power	**Future reviews and other comments** "The Reasonability Limit Values are currently set at very high levels. We [ERM Power] recommend that AEMO consider additional consultation on the Guidelines following the summer of 2018-19, and that analysis be undertaken on these values with regards to their ongoing effectiveness and suitability given their potential to result in additional costs to consumers... [ERM Power] support ongoing regular review of both inputs to the calculation methodology and the process."	AEMO will review the operation and performance of the Guidelines after summer 2018-19 and determine if changes to the Guidelines are required, or further improvements can be identified. This review will include assessment of the appropriateness of the reasonability limits.

| 10. | Energy Australia | **Revision of definition of RXS**

"While AEMO's current process for allocating energy limited plant is an improvement, the allocation of this capacity could be improved to further reflect likely actual outcomes in the market.

[It] would be beneficial if AEMO could publish all outcomes of the STPASA process (e.g. all dispatch outcomes and contributions to reserve calculations)... [to] allow participants to examine the energy limited plant allocations and its potential impact on the system... [It would] also be beneficial for AEMO to provide more clarity around how they dispatch (and in what merit order) generators and the amount imported across interconnectors when determining the remaining allocation to energy limited plant."

Energy Australia would like clarity around "why AEMO has chosen to define the 50% probability of exceedance (POE) scheduled demand including the output of non-scheduled generating units... [and consider it] would be beneficial to separate non/semi-scheduled wind and solar. We propose that AEMO include the non-scheduled generation with semi-scheduled generation and split solar and wind. It may also be beneficial to extend a similar approach to how the coal/gas fuel-mix is accounted for, allowing forecast errors to be better understood." | AEMO will investigate further optimisations to the PASA process allocation of capacity from energy limited plant as part of the PASA review project scheduled for mid-2019.

The PASA solution files published on AEMO's website and through the EMMS Data Model contain each of the components of the revised RXS definition.

The forecast value of the scheduled demand component of the proposed RXS definition is calculated using forecasts of the output of non-scheduled generating units and the output from rooftop solar generation. This is because non-scheduled and rooftop solar generation are significant generation sources that have the effect of reducing scheduled demand when they are at high levels. Not accounting for them when producing the forecast of scheduled demand could lead to significant errors in the load forecast model. The forecasts of output from non-scheduled generating units and rooftop solar generation are produced by AEMO's wind and solar forecasting systems and are subtracted from the forecast of demand to produce the forecast scheduled demand; the output of non-scheduled generation and rooftop solar is not included in the scheduled demand but are used in the model to produce the forecast of demand. As the non-scheduled component is already being used to produce the demand forecast, AEMO considers separating the non-scheduled component is unnecessary because the uncertainty of this is already reflected in the scheduled demand component. |
| 11. | Energy Australia | **RXS Errors**

"Energy Australia would like to understand the step change in CON_GEN_ERROR in South Australia beginning mid-2016." | This is related to changes to the bidding of Torrens Island units to include daily energy limits from mid-2016. |

12.	Energy Australia	**Input predictors** "Energy Australia would like to understand if AEMO has given consideration or focused upon input predictors that have had a greater impact when LOR conditions have been present historically"	AEMO considers that insufficient training data will be available if only historic LOR conditions are used to perform the sensitivity analysis to determine the input predictors.
13.	Energy Australia	**Confidence levels** "Energy Australia urge AEMO to continue to be transparent on the selection of confidence levels for FUM values going forward."	Noted.
14.	Origin	**General comments** "Origin strongly supports assessment of the Reserve Level Declaration Guidelines, with learnings from its operation since February being integrated before summer. We also propose that this is reviewed again in 2019, incorporating learnings from the 2018-19 summer."	Noted.
15.	Origin	**Transparency of what is setting reserve requirement** Origin suggest AEMO consider "provision of more transparent information on whether declaration of a LOR condition has been forecast from the FUM or through a deterministic method. This could provide guidance on the appropriate response by participants, and build confidence and understanding of the model."	AEMO considers that the publication of the value of the FUM, the largest credible risk and the two largest credible risks will provide the additional transparency required to determine what is setting the reserve requirement. AEMO has implemented changes to the Lack of Reserve Framework quarterly report to improve transparency of whether the reserve requirement is being set by the FUM or the largest credible risk(s). AEMO will consider publishing the specific parameters setting the level of the largest credible risk and two largest credible risks as part of the PASA review project scheduled for mid-2019.
16.	Origin	**Definition of RXS** Origin suggest AEMO "consider that energy constrained plants are modelled as using their fuel reserves at the time of day where maximum demand is forecasted."	AEMO will investigate further optimisations to the PASA process allocation of capacity from energy limited plant as part of the PASA review project scheduled for mid-2019.