AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

1 August 2017

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Chairman
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Dear Mr Pierce

Rule change proposal: Lack of Reserve Declaration

Please find attached a National Electricity Rule (NER) change proposal relating to the declaration of Lack of Reserve conditions.

The existing definitions of Lack of Reserve (LOR) conditions in NER clause 4.8.4 are no longer appropriate for identifying risks in the power system. AEMO wishes to replace them with a system triggered by a wider range of risks than those presently allowed for in the definitions.

One of these risks is short-term demand forecasting error, which was also recognised in a recommendation of the Independent Review into the Security of the National Electricity Market (Finkel Review) and by the Australian Energy Regulator's report into 8 February 2017. AEMO is developing a tool to continuously calculate and project the risk of errors in its short-term reserve forecasting, caused by changes in forecast demand or supply. This tool will be completed prior to the coming summer. AEMO is not seeking an expedited rule change, but desires to have this rule in place this summer to enable the LOR regime to immediately benefit from this tool.

For discussion on this rule change, please contact Ben Skinner, Market Development Specialist on (03) 9609 8769.

Yours sincerely

Brett Hausler
Executive General Manager – Regulation and Governance

Attachments:

1. Lack of Reserve Declaration PDF version
2. Lack of Reserve Declaration Word version

ELECTRICITY RULE CHANGE PROPOSAL

LACK OF RESERVE DECLARATIONS

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CONTENTS

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1. SUMMARY

The National Electricity Rules (NER) lay out a set of definitions for Lack of Reserve (LOR) levels which are intended to indicate the risk of involuntary load interruption. AEMO must continually assess current and short-term future conditions against these levels and publish declarations when the conditions occur. The levels trigger firstly the seeking of a market response, and secondly intervention by AEMO if necessary.

The LOR 1 and 2 definitions are based around the concept of credible contingency events, generally the loss of large conventional generating units. This simple criterion was traditionally used for assessing short-term reliability, but is progressively becoming less relevant in the changing power system.

Instead, significant, rapid deteriorations in short-term power system conditions now frequently occur due to non-contingency based variations. The key variables are:

- Short-term grid demand forecast error, particularly during extreme hot weather, which is in turn affected by surprisingly small errors in weather forecasts.
- Short-term large-scale wind and large-scale solar generation forecast error.
- Widespread partial availability reductions in thermal generation during stressful ambient conditions.
- Variations in network constraints.

AEMO considers it essential to implement a more sophisticated warning and intervention trigger derived from its view of the probability of involuntary load interruption. This probability would consider the variables listed above as well as traditional large contingencies.

The proposed rule change clarifies the purpose of LORs and retains the present NER obligations upon AEMO to assess and declare them. The detailed definition of each level is however moved out of the NER and transferred to an AEMO maintained public document, the “Reserve level declaration guidelines”. This approach allows AEMO to employ sophisticated risk assessment measures and to improve the measures over time.

A rapid deterioration in power system conditions occurred on 8 February 2017[1], and, as contingency-based risks were not the cause, the LOR process did not provide adequate warning of the true risk of the load interruption that ultimately occurred. AEMO desires that a new LOR regime be in place preferably by the start of summer, but no later than 1 January 2018, in order to better manage the highest risk period of the coming summer. AEMO has begun analysis towards the development of a risk forecasting tool and will develop the first edition of the new guidelines in parallel with the making of this Rule change.

[1] http://www.aemo.com.au/-/media/Files/Electricity/NEM/Market_Notices_and_Events/Power_System_Incident_Reports/2017/System-Event-Report-South-Australia-8-February-2017.pdf

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2. RELEVANT BACKGROUND

2.1 Current Framework

The LOR concept is a key mechanism by which AEMO announces a risk of involuntary load interruption from real-time up to the end of the short-term horizon[2]. LOR declarations are notified to the market under clause 4.8.5 of the NER, and, where not resolved by a market response, can trigger an AEMO intervention. Information on AEMO intervention in these circumstances is described in the Reliability Standard Implementation Guidelines[3] and in AEMO's System Operation Procedure 3707[4].

Clause 4.8.4 of the NER sets out specific definitions for Lack of Reserve (LOR) levels based around the concept of credible contingency events, generally the loss of a large conventional generating unit. These have three levels:

- LOR3 means involuntary load interruption is occurring, or is expected to occur.
- LOR2 means a single credible contingency event would lead to involuntary load interruption.
- LOR1 means two single credible contingency events, but not occurring simultaneously, would lead to involuntary load interruption.

The NER provide no clear purpose of the LOR regime, except that they exist within a suite of obligations and intervention mechanisms relevant to power system operations.

2.2 Narrative of Issue and Proposed Changes

Clause 4.8.4 requires AEMO to contemplate credible contingency events, noting "This would generally be the instantaneous loss of the largest generating unit on the power system". The simple criterion of the loss of a large conventional generating unit was traditionally used for indicating the short-term reliability of power system. This has progressively become less relevant and the continued reliance on this criterion means the LOR1 and 2 mechanisms are increasingly inadequate to forecast situations of real risk.

Instead, significant, rapid deteriorations in short-term power system conditions now frequently occur due to non-contingency based variations. The key variables are:

- Short-term demand forecast error, particularly during extreme hot weather, which is in turn affected by surprisingly small errors in weather forecasts or forecasts of the behaviour of distributed energy resources.
- Short-term large-scale wind and solar generation forecast error.
- Widespread partial availability reductions in thermal generation during stressful ambient conditions.
- Variations in network constraints, for example due to changes in right-hand-side (RHS) quantities, such as local network demand.

All NEM regions frequently experience all of the above error sources, and at times their collective size may swamp the largest traditional generation contingency. For example in South Australia, whilst the underlying risk of forecast error is increasing, South Australia's largest generation contingency has actually declined in size following the closure of Northern Power station. Non-contingency based deviations from forecast were the main cause of reserve deterioration on 8 February 2017 in South Australia. An LOR2 was first declared at 17:13AEST, followed by load shedding from 18:03AEST. The LOR2 declaration occurred too late to implement intervention options that may have avoided the need for load shedding. The LOR regime's limitations are similarly recognised in section 3.1.4 of the AER report into this event[5].

[2] For the purposes of the LOR, AEMO applies the same time horizon as the Short-term PASA, i.e. one week into the future.
[3] https://www.aemo.com.au/Stakeholder-Consultation/Consultations/Reliability-Standard-Implementation-Guidelines
[4] https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3707---Intervention-Direction-and-Clause-4-8-9-Instructions.pdf
[5] https://www.aer.gov.au/wholesale-markets/market-performance/prices-above-5000-mwh-8-february-2017-sa

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Thus the contingency-based LOR system is no longer fit for purpose. AEMO instead wishes to implement a more sophisticated market notice system and intervention trigger derived from its view of the probability of involuntary load interruption, considering all sources of forecast error.

The proposed rule change creates a clearer purpose for the LOR regime and retains the present NER obligations upon AEMO to assess, declare and act upon LOR conditions where relevant. The detailed definition of each level is however moved out of the NER and transferred to an AEMO maintained and consulted public document, the "Reserve level declaration guidelines". The guidelines will permit AEMO to develop sophisticated risk assessment measures and to improve the measures over time.

AEMO is developing the initial version of these guidelines in parallel with the AEMC's consultation on this rule change proposal. AEMO intends to provide a draft of the first version of the guidelines to the AEMC in time for the publication of its draft determination on the rule change. The final stage of the AEMC's rule consultation will therefore be assisted by a fulsome draft of the guidelines. Submissions to the AEMC which comment upon the draft guidelines will be taken into account by AEMO in moving the guidelines from draft to final.

The LOR regime is the most important mechanism by which AEMO communicates short-term risk to the industry, government and customers. Stakeholder education on the proposed changes to the regime is important. AEMO intends to also provide explanatory material and to present the changes in industry forums.

To assist understanding of the significance of the potential decline of system reserves in the short-term horizon, AEMO has provided some recent historical examples in Appendix B.

2.2.1 Credible contingencies and the Reliable Operating State

The concept of a credible contingency event (NER 4.2.3) is key to operating a power system. The ability to withstand a credible contingency and remain in a satisfactory state is what determines a *secure* operating state (NER 4.2.4). The importance of credible contingencies to system security is not affected by this rule change in any way.

LORs indicate an actual, or a risk of, involuntary load interruption due to supply shortfall. This represents a potential departure from a *reliable* operating state. NER 4.2.7 states that the power system is not reliable if load shedding is occurring or is expected. This is consistent with the current LOR3 definition, which AEMO intends to retain. LOR1 and LOR2 indicate a significant probability of reaching LOR3.

Even when the power system is no longer in a reliable operating state, AEMO monitors all credible contingencies and makes all efforts, including the interruption of additional load where necessary, to remain in a *secure* operating state.

Whilst the loss of a large generating unit is a risk that should be taken into account, it is not the only, nor most likely, reason for the supply/demand balance to deteriorate. Unlike security, *reliability* is not necessarily linked to a credible contingency. Nevertheless, at market start the LOR1 and LOR2 levels were linked to the largest generating unit loss, as this had been previous practice and, at that time, was the dominant power system reliability risk.

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3. STATEMENT OF ISSUE

3.1 Current Rules

AEMO may declare these conditions in relation to the present or a future period of time:[6]

(b) *Lack of reserve* level 1 (LOR1) – when AEMO considers that there is insufficient capacity reserves available in an operational forecasting timeframe to provide complete replacement of the *contingency capacity reserve* on the occurrence of the *credible contingency event* which has the potential for the most significant impact on the *power system* for the period nominated. This would generally be the instantaneous loss of the largest *generating unit* on the *power system*. Alternatively, it might be the loss of any *interconnection* under *abnormal conditions*.

(c) *Lack of reserve* level 2 (LOR2) – when AEMO considers that the occurrence of the *credible contingency event* which has the potential for the most significant impact on *the power system* is likely to require *involuntary load shedding*. This would generally be the instantaneous loss of the largest *generating unit* on the *power system*. Alternatively, it might be the loss of any *interconnection* under *abnormal conditions*.

(d) *Lack of reserve* level 3 (LOR3) – when AEMO considers that *Customer load* (other than *ancillary services* or contracted *interruptible loads*) would be, or is actually being, interrupted automatically or manually in order to maintain or restore the security of the *power system*.

These rather dense definitions are unchanged from market start, resulting from an effort to codify pre-market approaches of assessing risk through the loss of one or two large generating units. They are best tackled in reverse order:

- LOR3 indicates that involuntary load shedding is currently occurring, or is expected to occur in the most likely forecast.
- LOR2 indicates that the occurrence of the largest considered credible contingency will lead to involuntary load shedding. This may apply to the present time, or in relation to the expected conditions of a forecast.
- LOR1 effectively means that the power system has insufficient reserve to cover the loss of twice the largest independent considered credible contingency. The complex wording of replacing contingency capacity reserve with capacity reserve was intended to allow AEMO to contemplate that the two contingencies will not occur simultaneously (which would be a very serious, non-credible event). AEMO assumes there will be sufficient time to re-secure the system between the contingencies.

With respect to what credible contingency events to consider, the definitions mention this would generally be the largest generating unit and AEMO considers these at all times in its LOR assessments. The loss of interconnection under abnormal conditions is also explicitly mentioned, and AEMO considers the loss of interconnection:

- Where one circuit of a dual circuit interconnection is out of service.
- Where the loss of twin circuits that form an interconnection are re-classified as being a credible contingency.

In practice AEMO also considers the loss of the Basslink cable at all times as a credible contingency for LOR declaration. AEMO does not generally consider the loss of other transmission line elements as contingencies for the purposes of LOR declaration.

AEMO must publicly declare any LOR conditions under NER clause 4.8.5.[7] If a market response does not resolve the issue or there is insufficient time to allow for a response, AEMO may intervene in the market, generally by issuing directions. In practice, intervention may occur following a declared LOR2 or LOR3.

3.2 Issues with the Current Rule

As discussed in section 2.2, AEMO wishes to institute a more sophisticated risk warning system based on the underlying probability of involuntary load interruption due to all causes rather than one based on generation

[6] See clause 4.8.4 of the NER.
[7] See also short-term reserve procedure http://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3703---Short-Term-Reserve-Management.pdf

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contingencies. AEMO also wishes to have a flexible system that enables the probability measures to evolve with the changing market.

The existing rules for LOR1 and LOR2 are inextricably linked and limited to identifiable contingencies and are therefore incompatible with such an approach.

Power system risk assessment is very difficult to express within the legal framework of the NER. The existing approach has led to:

- Inflexibility in the definitions that restricts AEMO's ability to:
    - Make use of more sophisticated probabilistic risk assessment techniques.
    - Evolve the risk measures to take account of the changes in the power system.
- Great difficulty for participants in understanding what true risk is implied by an LOR declaration.
- Lack of transparency in exactly what contingencies AEMO will contemplate and what tools it will use to assess the risk.
- Lack of clarity regarding the underlying purpose of the LOR mechanism.

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4. HOW THE PROPOSAL WILL ADDRESS THE ISSUES

4.1 How the Proposal will address the Issues

AEMO proposes to change the basis for LOR in the NER by:

- Including within the NER a clear role and purpose for LOR declarations.
- Obliging AEMO to create published guidelines, which will:
    - Define and explain each LOR level in accessible language.
    - Explain how AEMO will assess them across different time horizons.
- Removing the current "hard-wired" contingency-based LOR definitions from the NER.

The guidelines will allow AEMO to develop a risk assessment technique fit-for-purpose for the evolving NEM, and continue to refine that technique as necessary to respond to ongoing changes.

The proposed rule enables AEMO to develop the initial guidelines in parallel with the AEMC's consultation on this rule. AEMO anticipates it can have the first edition of the guideline in place by the start of the upcoming summer.

4.2 Lack of Reserve Guidelines

AEMO is presently analysing the historical short-term accuracy of:

- Short-term demand forecasts in extreme demand conditions.
- Short-term accuracy of the Australian Wind (and Solar) Energy Forecasting systems (AWEFS and ASEFS).
- Short-term maximum availability predictions from thermal units during high ambient temperatures.

These sources of variances will be incorporated with conventional contingencies to calculate a more accurate distribution of the risk of involuntary load interruption.

The analysis will consider the variance over different time horizons, e.g. the above variances tend to be small compared to contingency risk one hour ahead but much larger 24 hours ahead.

The findings of this analysis will lead directly into AEMO's development of the new LOR guidelines.

AEMO recognises that the industry is familiar with the current three-tiered approach and therefore intends to similarly categorise its initial LOR assessment levels. It will also attempt to broadly replicate the probabilities of a single (LOR2) and double (LOR1) generating unit loss in a conventional power system which is not subject to the error sources listed above.

It is intended to further develop the guidelines over time as:

- Further changes occur in the power system affecting short-term forecasting risks.
- AEMO develops progressively more sophisticated probabilistic measurement techniques.
- The industry becomes progressively familiar with non-contingency based risk assessments.

The proposed NER change is structured to encourage such development. For example, AEMO is intentionally provided with the flexibility to increase the number of LOR levels over time.

4.2.1 Approach to determining probabilities

At a high level, a region's reserves can be described as:

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1. Bid scheduled generation availability; plus
2. Forecast semi-scheduled generation and large non-scheduled generation; plus
3. Surplus reserve available from adjacent regions;
4. Less operational demand[8].

The calculation is performed by the STPASA and PDPASA tools. Each tool solves for reserves for each region and for every half-hour within its time horizon. Their objective functions are to maximise reserves in each specific region for the half-hour it is solving. Generation and inter-regional reserve sharing is constrained by a full set of co-optimised network constraints, which ensures that where multiple generating units and/or interconnectors are limited by a shared constraint, that only the total amount of energy transmissible to customers is considered.

The resulting reserve calculation is affected by many variable inputs. Some examples of changing outputs are shown in Appendix B.

AEMO is presently analysing historical forecast errors in both the inputs and the outputs to PASA. A Bayesian Belief Network is being trialled that will find correlations between historical forecast errors and relevant conditions, such as the forecast lead-time, ambient temperature, expected wind and solar forecast.

4.2.2 Treatment of largest contingency

Mathematically, the unexpected loss of, say, a large generating unit is no different to all the other sources of potential forecasting error. It may be possible, therefore, to treat this event as just another uncertainty with a known probability. An LOR declaration generation reserve margin allowing for, say, 90% confidence may actually be smaller than the largest generating unit loss, where that loss is rare.

Without ruling out such an approach in the future, AEMO does not intend to do this for the initial LOR guidelines. AEMO's operational staff, and the market in general, are familiar with declaring risks associated with contingencies. Therefore AEMO intends that the LOR declaration margins should initially remain at least as large as the current approach. This could be achieved in either of two ways:

- Setting the margin at the larger of the largest considered contingency(ies) or a probabilistic margin.
- Setting the margin at the largest considered contingency(ies) *plus* an allowance for non-contingency based variations.

AEMO is presently investigating which is the more appropriate approach.

4.2.3 Structure of Guidelines

As discussed above, mathematical analysis is underway currently to determine the characteristics of historical reserve forecast changes and its sensitivity to various independent factors. This will lead to a distribution of possible variations from a reserve forecast. It is intended to trigger LORs when the pessimistic tail of that distribution indicates there is a statistically significant risk of involuntary load shedding. The variables to be considered, and the appropriate confidence intervals will be informed by the analysis.

Given that this work is ongoing, it is not yet possible to provide a draft of the guidelines. AEMO is targeting the first draft to coincide with the AEMC's release of its draft determination on this rule proposal; see discussion in section 4.3.1. The following example structure is presented for illustration only.

1. Using historical data, AEMO will determine a combined distribution of short-term forecast error resulting from all of the following STPASA and Pre-dispatch inputs in each region:
    a. Operational demand forecast.

[8] "Operational demand" refers to the main grid demand, and, unlike "scheduled demand" includes demand met by large non-scheduled generation. More information is available here: http://www aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/NEFR/2016/Operational-Consumption-definition---2016-update.pdf

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b. Unconstrained AWEFS and ASEFS generation forecast.

c. Partial changes in the availability of scheduled generation (excluding complete outages[9]).

2. AEMO will publish a single MW value applicable to the [90%] confidence level[10] of the distribution

   a. For each region.

   b. For each half-hour ahead of dispatch time up to one week ahead.

3. LOR3 will be declared in a region(s) or location(s)

   a. When Customer load (other than ancillary services or contracted interruptible loads) are being interrupted automatically or manually in order to maintain the security of the power system.

   b. For a period in the future when the most likely forecast of STPASA or Pre-dispatch indicates that the conditions in 3a will be met.

4. LOR2 will be declared in a region(s) or location(s)

   a. When the largest applicable contingency would result in the conditions in 3.

   b. For a period in the future when the most likely forecast of STPASA or Pre-dispatch less the relevant value determined in 2 less the largest applicable contingency value would result in the conditions in 3a[11].

5. LOR1 will be declared in a region(s) or location(s)

   a. At a time when the largest and second largest applicable contingency would result in the conditions in 3a.

   b. For a period in the future when the most likely forecast of STPASA or Pre-dispatch less the relevant value determined in 2 less the largest and second largest applicable contingency value would result in the conditions in 3a.

6. The two largest applicable contingency values will be determined for each region. Contingencies assessed will include:

   a. The largest non-aggregated generating unit or wind or solar farm on-line.

   b. Basslink.

   c. Other critical network elements (to be defined).

The above structure is intended only as an illustrative outline. AEMO also proposes to include information in the guidelines on the technique used for analysing the historical data and its refresh process.

4.2.4 Guidelines Consultation

The guideline is intended to be consulted, explained to the market and published. The proposed rule identifies the key stakeholders AEMO will be specifically required to consult with (without limitation), as those who may be most directly affected by a reserve level declaration. An important part of the development process will also be industry education.

Note AEMO has not proposed that these consultations be subject to the formal Rules Consultation Procedures (RCP) in rule 8.9 of the NER, because:

[9] The risk of full outages is to continue to be handled deterministically for the initial set of guidelines (see section **Error! Reference source not found.**)
[10] The appropriate confidence interval is yet to be determined: 90% is suggested only for illustrative purposes.
[11] This illustration uses the contingency plus margin technique described in section **Error! Reference source not found.** for example purposes only. It could alternatively use the "greater of" technique.

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- For the initial guidelines, there is insufficient time to complete a RCP prior to the upcoming high risk summer period.
- The proposed requirement for published guidelines is replacing a determination process that is currently opaque and not subject to consultation.
- The subject of the guidelines will be of a technical nature derived from historical objective measurement. As such, the time and resource cost required of both AEMO and its stakeholders in undertaking a full RCP is not justified and could hinder the ability to respond in a timely way to new developments.
- An RCP requirement is inconsistent with the level of consultation used for several other procedures or guidelines of equal or greater significance and complexity under the NER, including the power system operating guidelines (4.10.1(a)), reclassification criteria (4.2.3B(d)) and local black system procedures (4.8.12(e)).

The proposed rule does, however, include a number of more detailed requirements to provide assurance that AEMO will conduct at least one round of formal consultation and will consider all submissions in determining the guidelines. A minimum four year review requirement is also proposed.

A transitional clause will be required to recognise that consultation on the first set of guidelines is likely to be more limited and largely undertaken prior to the AEMC's final Rule determination.

4.3 Stakeholder Engagement

AEMO has not engaged in any formal consultation with stakeholders to date on the form of the proposed rule.

AEMO is not aware of any opposition to improving the LOR regime in this manner and considers the proposal to be consistent with findings and recommendations from recent reviews. Reports on the events of 8 February 2017 have clearly identified the risks created by short-term demand forecast error.[12] The Independent Review into the Security of the National Electricity Market (Finkel Review) listed improving the short-term demand forecast methodology as part of its recommendation 1.1[13]. Initial work shows that AEMO's short-term demand forecast error can only be marginally improved, and so the more prudent approach is to understand and make allowance for this error.

4.3.1 Initial Guidelines

AEMO will develop the initial set of guidelines concurrently with the AEMC's consideration of this rule change proposal. No draft of the guidelines is available at the time of the rule change submission, however it is intended to have a draft available for comment at the time of the publication of the AEMC's draft determination, which could be published together on the AEMC's website. This should present a convenient opportunity for stakeholders to comment on both the rule draft determination and the initial LOR guidelines in the one consultation process.

AEMO will take into account comments upon its draft guidelines when preparing the initial guidelines that will take effect from the date of making this rule change.

[12] See https://www aer.gov.au/wholesale-markets/market-performance/prices-above-5000-mwh-8-february-2017-sa and https://www.aer.gov.au/wholesale-markets/market-performance/prices-above-5000-mwh-8-february-2017-sa
[13] http://www.environment.gov.au/energy/national-electricity-market-review

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5. PROPOSED RULE

5.1 Description of the Proposed Rule

See Appendix A for a draft of the proposed Rule.

Changes to Clause 4.8.4

The existing LOR definitions would be removed from the NER and replaced with a high level description of a lack of reserve condition, to be declared in accordance with guidelines. A high level objective for the declaration is provided "that the probability of involuntary load shedding is, or is forecast to be, more than remote".

New Clause 4.8.4A

This creates the obligation on AEMO to create reserve level declaration guidelines with a set of minimum criteria that represent a considerably more sophisticated and transparent approach than the existing NER provisions. AEMO must determine guidelines that meet the following requirements:

- (b)(1) - Describe how the probability of involuntary load shedding is assessed.
- (b)(2) – Take the forecasting interval into account, so, unlike the current arrangement, AEMO will contemplate how the likelihood and size of errors change over time.
- (b)(3) – Retain a similar structure of increasing levels of probability of load shedding ("traffic light" structure), but allowing the number of levels to change over time, with a minimum number of two.
- (c) – Determine an assessment method that is consistent with good electricity industry practice and takes into account, as a minimum:
    - (c)(1) Contemporary conditions. For example, if the base forecast is for still conditions there is no risk of underestimating wind generation.
    - (c)(2) The nature and likelihood of events that can occur at unpredictable times.
    - (c)(3) Prudent allowances for forecast error.

Paragraph (b)(4) requires AEMO to consult on the development of the guidelines with the parties most directly interested in power system risk and the probabilities of AEMO intervention.

Paragraph (b)(5) requires AEMO to review the guidelines at least every four years. AEMO anticipates that the guidelines will evolve quicker than this for the first few years as the LOR regime catches up to the existing power system, but thereafter the need for revisions will stabilise.

5.2 Minor/Consequential Rule Changes

See Appendix A.

Deletion of 3.13.4(f)(6) (i) and (ii)

Clause 4.8.5 of the NER obliges AEMO to publish LOR declarations as soon as possible. This is primarily conveyed to the market by way of market notices. AEMO also publishes a procedure on this matter[14].

Clause 3.13.4(f)(6) also obliges AEMO to publish LOR declarations automatically within pre-dispatch information. This is excessively prescriptive upon AEMO's communication method and in any case redundant in the presence of 4.8.5. Complying with this obligation has been straightforward for simplistic LORs, but may become more difficult over time with more sophisticated measures, and may unnecessarily frustrate the rollout of improved LORs at some time in the future.

[14] See also short-term reserve procedure http://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Power_System_Ops/Procedures/SO_OP_3703---Short-Term-Reserve-Management.pdf

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As with all market information, AEMO will continue to design its pre-dispatch information systems in consultation with participants, considering both its value and cost.

Definitions

The proposed rule will amend the definition of lack of reserve and create a new definition for the guidelines, consistent with the substantive rule changes in clauses 4.8.4 and 4.8.4A.

Savings and transitional rules

AEMO has not proposed draft transitional provisions, as these will depend on the final Rule and time at which the AEMC makes its final determination. AEMO expects that, as a minimum, a transitional rule will be required to recognise the consultation undertaken by AEMO on the first version of the reserve level declaration guidelines in parallel with the AEMC's consultation on the proposed Rule.

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6. HOW THE PROPOSED RULE CONTRIBUTES TO THE NATIONAL ELECTRICITY OBJECTIVE (NEO)

The NEO includes promoting efficient operation and use of electricity services for the long-term interests of customers with respect to price and reliability.

LOR declaration helps ensure reliability of electricity supply to customers by warning of a potential shortfall in time for it to be addressed. It is important that the declarations neither under nor over-state these risks.

- If risks are under-estimated, then AEMO will not use the LOR warning system early enough to seek a market response, and options to intervene will be overlooked. This will ultimately lead to lower security to customers.
- If risks are frequently over-stated, they may be ignored by the market, or lead to unnecessary AEMO interventions recovered from the market, thereby increasing customer prices.

By enabling AEMO to use more accurate probabilistic triggers to LOR declaration, the rule change will contribute to the NEO primarily by improving customer continuity of supply and, over time, lowering customer prices through more efficient participant preparation for high risk periods and better targeted interventions by AEMO.

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7. EXPECTED BENEFITS AND COSTS OF THE PROPOSED RULE

7.1 Costs

As a result of concerns raised by the Australian Energy Regulator regarding the 8 February 2017 event and Finkel Review recommendation 1.1, AEMO is presently assessing the true probabilistic risks of its short-term forecasts. Regardless of the outcome of this rule change, AEMO expects to develop tools derived from this analysis prior to the coming summer and to deploy them in the operational environment. Thus the bulk of AEMO's implementation costs associated with the new risk assessment regime are already committed.

The implementation costs of the rule itself therefore is limited only to the preparation, consultation and education of the new guideline. The rule change does not require the construction of any new communication processes.

No participant or government implementation costs are expected to flow from the NER change.

Given the evidence presented in Appendix B, it is likely that the incidence of LOR1 and LOR2 declarations will increase in the new regime. As a result, there will be some indirect costs associated with more frequent calls for market response or AEMO intervention. This will be mitigated by selecting an appropriate confidence interval for the errors, that trades these costs off against the benefit of fewer customer interruptions described below.

7.2 Benefits

The existing LOR arrangements fulfil a valuable alerting service to market participants, government and AEMO's own operations. The notification framework works well, reaching all necessary stakeholders. Having AEMO's own intervention actions triggered by the same alert provides transparency and predictability for the market.

The rule change keeps this alerting system entirely intact, and improves it by feeding it with more accurate risk calculations. This will:

- Give greater confidence to stakeholders that the LOR system represents genuine risks.
- Provide additional transparency to stakeholders as to what conditions will lead to LOR declaration.
- Encourage a market response to occur earlier during periods of significant non-contingency based risk.
- Allow AEMO to intervene earlier during periods of significant non-contingency based risk.

The primary benefit to customers is the reduction of involuntary load interruption where a better informed market or AEMO is able to take action in time to provide additional system reserves at times of genuine risk.

Finally, not making the rule would create lingering costs and confusion in having multiple risk assessment measures: those that AEMO uses internally based on underlying probabilities and those that it is obliged to declare to the market in accordance with the current rules.

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APPENDIX A: PROPOSED RULE

DRAFT RULE

Based on National Electricity Rules Version 93

CHAPTER 3 MARKET RULES

Amend clause 3.13.4 as follows:

3.13.4 Spot market

(f) Details of the *pre-dispatch schedule* to be *published* must include the following for each *trading interval* in the period covered:

[…]

(6) identification and quantification of:

~~(i) when and where the projected conditions are found to be inadequate;~~

~~(ii) any *trading intervals* for which *low reserve* or *lack of reserve* conditions are forecast to apply;~~

{Remainder of clause unchanged}

CHAPTER 4 POWER SYSTEM SECURITY

Amend clause 4.8.4 as follows:

4.8.4 Declaration of conditions

AEMO may declare the following conditions in relation to a period of time, either present or future:

(a) *Low reserve* condition – when *AEMO* considers that the balance of *generation capacity* and demand for the period being assessed does not meet the *reliability standard* as assessed in accordance with the *reliability standard implementation guidelines*.

(b) *Lack of reserve* condition – when *AEMO* determines, in accordance with the *reserve level declaration guidelines*, that the probability of *involuntary load shedding* is, or is forecast to be, more than remote.~~*Lack of reserve* level 1 (LOR1) – when *AEMO* considers that there is insufficient *capacity reserves* available in an operational forecasting timeframe to provide complete replacement of the *contingency capacity reserve* on the occurrence of the *credible contingency event* which has the potential for the most significant impact on the *power system* for the period nominated. This would generally be the instantaneous loss of the largest *generating unit* on the *power system*. Alternatively, it might be the loss of any *interconnection* under *abnormal conditions*~~.

(c) ~~[**Deleted**]*Lack of reserve* level 2 (LOR2) – when *AEMO* considers that the occurrence of the *credible contingency event* which has the potential for the most significant impact on the *power system* is likely to require *involuntary load shedding*. This would generally be the instantaneous loss of the largest *generating unit* on the *power system*. Alternatively, it might be the loss of any *interconnection* under *abnormal conditions*.~~

(d) [Deleted]~~*Lack of reserve* level 3 (LOR3) – when *AEMO* considers that *Customer load* (other than *ancillary services* or contracted *interruptible loads*) would be, or is actually being, interrupted automatically or manually in order to maintain or restore the security of the *power system*.~~

Insert a new clause 4.8.4A after clause 4.8.4 as follows:

4.8.4A Reserve level declaration guidelines

(a) *AEMO* must make and *publish reserve level declaration guidelines* that set out how *AEMO* will determine a *lack of reserve* condition.

(b) The *reserve level declaration guidelines* must:

(1) describe how *AEMO* continually assesses the probability of *capacity reserves* being insufficient to avoid *involuntary load shedding* given reasonably foreseeable conditions and events;

(2) describe how that assessment applies in relation to different periods of time;

(3) specify two or more 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 *involuntary load shedding*; and

(4) be reviewed at least once every four years.

(c) The probability assessment described in the *reserve level declaration guidelines* must be consistent with *good electricity industry practice* and must take into account, without limitation:

(1) actual and forecast *power system* conditions and environmental or similar conditions;

(2) the likelihood of the occurrence and impact on the *power system* of events that are foreseeable in nature but unpredictable in timing; and

(3) prudent allowances for forecasting error.

(d) Before making or amending the *reserve level declaration guidelines*, *AEMO*:

(1) must provide the proposed guidelines to *Generators*, *Transmission Network Service Providers*, *Jurisdictional System Security Coordinators*, together with an explanatory statement and an invitation to make submissions on the proposed guidelines;

(2) must allow at least [15] business days for submissions in response to the invitation;

(3) may hold conferences and information sessions, or undertake such other consultation on the proposed guidelines as *AEMO* considers appropriate; and

(4) must, in determining to make or amend the guidelines, consider any submissions made under sub-paragraph (2), and *publish*:

(i) the reasons for its determination;

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(ii) a summary of each issue raised in those submissions that *AEMO* considers to be material; and

(iii) *AEMO's* response to each such issue.

CHAPTER 10 GLOSSARY

Amended definition:

***lack of reserve* (*LOR*)**

~~A~~ny ~~of the~~ condition~~s~~ ~~described~~ declared by *AEMO* under ~~in~~ clause 4.8.4(b)~~, (c) or (d)~~.

Insert new definition:

reserve level declaration guidelines

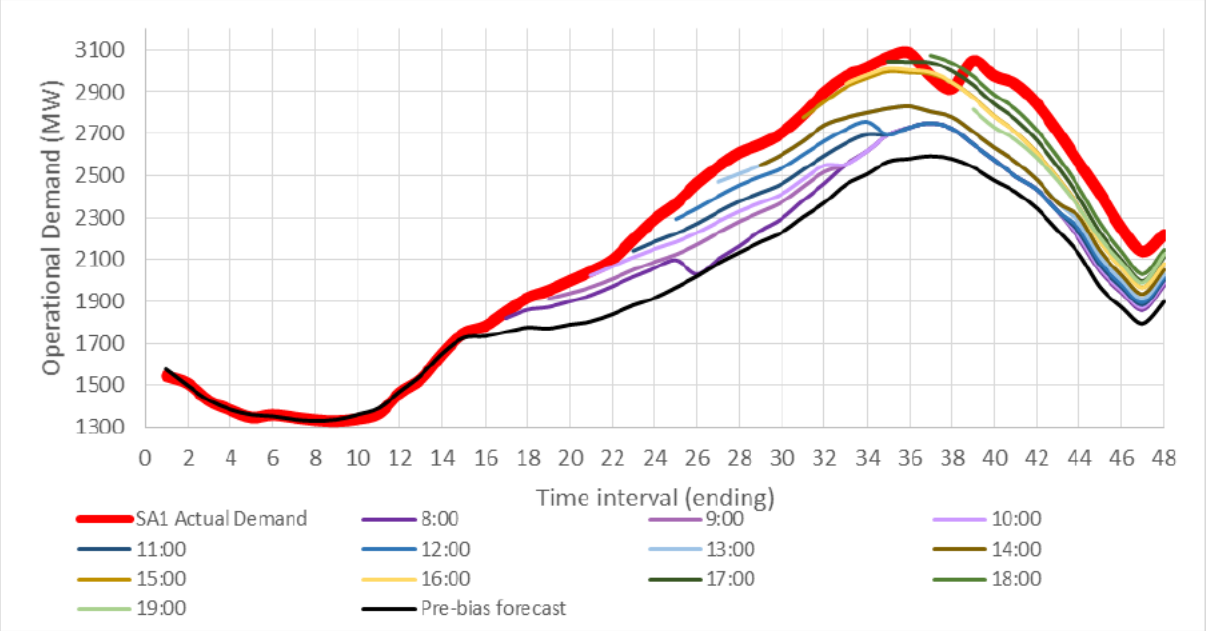
The guidelines developed and *published* by *AEMO* under clause 4.8.4A.

APPENDIX B: HISTORICAL EXAMPLES OF SHORT-TERM RESERVE VARIATION

8 February 2017

The events of this day are detailed in reports by AEMO and AER[15]. In the lead up to this hot South Australian afternoon, PASA indicated reserves were sufficient to avoid load interruption, even after a large conventional generator unit loss. Nevertheless, reserves declined markedly in the early afternoon, principally caused by:

- Operational demand increasing by almost 400MW above its 24 hour ahead forecast.
- Wind generation forecast declining by about 100MW.
- A combination of generator partial forced outages and some full outages of small units leading to these supplies declining by a total of 150MW.



The graph above shows how one factor, the demand forecast, progressively increased through the day.

LOR2 was eventually declared at 17:13AEST. An intervention option was identified, but required four hours' notice. Involuntary load shedding was ordered at 18:03AEST.

12 February 2017

This hot day in Queensland began with comfortable expected reserve levels. The demand expected for 18:00AEST grew by almost 300MW through the afternoon. One 150MW unit had a full forced outage, however there were numerous partial outages at various units summing to a total of approximately 700MW reduction in capacity.

As shown in the following graphs, a net fall of over 1000MW in Queensland reserves was therefore experienced late in the day.

[15] See http://www.aemo.com.au/-/media/Files/Electricity/NEM/Market_Notices_and_Events/Power_System_Incident_Reports/2017/System-Event-Report-South-Australia-8-February-2017.pdf and https://www.aer.gov.au/wholesale-markets/market-performance/prices-above-5000-mwh-8-february-2017-sa

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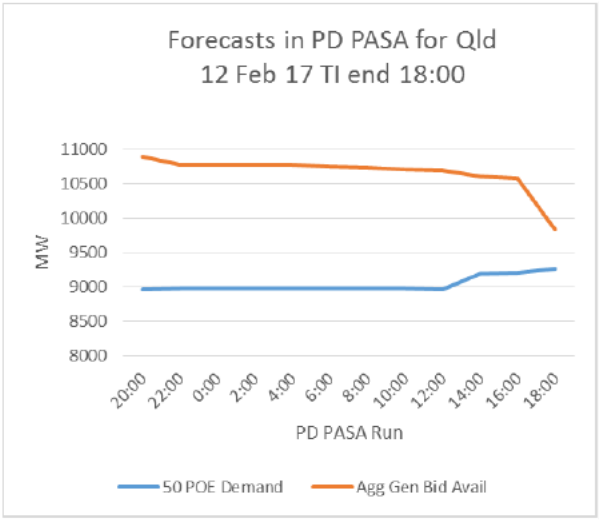

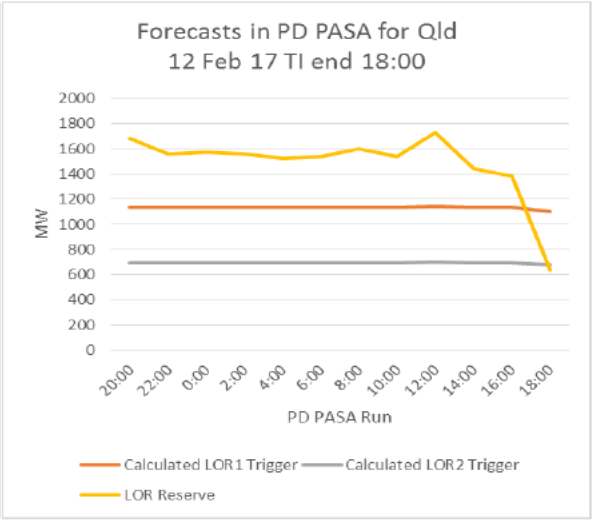

AEMO is presently studying the performance of units' actual capacities in high temperature conditions against their originally bid availability. Queensland 12 February 2017 is an extreme example, however AEMO's initial analysis suggests that partial reductions in capacity across a range of units is common in hot weather. The declines are mostly due to unforeseen limitations: generators are already required to adjust their bid availability for any predictable changes in capacity given the weather forecast.

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