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7 July 2022

Mr Charles Popple, Chair
Reliability Panel
c/- Australian Energy Market Commission
PO Box A2449
SYDNEY SOUTH NSW 1235
Submitted online
REL0082

Dear Charles,

Draft Report – Reliability Standard and Settings Review

This letter and attachment constitute AEMO's submission to the consultation Draft report, published 9 June, for the 2022 Review of the reliability standard and settings (RSSR).

AEMO welcomes the work of the Panel in preparing the Draft Report, particularly with respect to incorporating tail risk within the standard.

The attachment is in three parts discussing the:

1. need to include tail risk within the standard for the upcoming reliability and standard settings period;
2. discussion on the modelling results; and
3. specifics of the reliability settings.

In summary, AEMO considers the Panel should: account for tail risk, noting that this could be done by lowering the allowable unserved energy (USE); reconsider modelling assumptions that indicate lower levels of USE as inefficient; revise the modelling of the settings; and prioritise improvement in reliability provided by market mechanisms.

If you have any questions please contact David Scott, Manager – Markets and Operations Regulation, david.scott@aemo.com.au.

Yours sincerely,

Kevin Ly

Executive General Manager – Reform Delivery (acting)

Attachments: as stated above.

Attachment 1

Need to include tail risk within the reliability standard.

This section discusses the form of the reliability standard, provides information on tail risk and argues for it to be included in the reliability standard.

The Draft Report requests stakeholder feedback on the Panel's observations for the form of the standard. In response, AEMO agrees with the following observations[1]:

- a fundamental shift in the NEM's reliability risk profile will occur over the coming decade;
- expected USE is a more suitable metric for the form of the reliability standard rather than LOLE and LOLP, because it incorporates size and probability;
- more than one metric may be essential in order to capture features of both expected and more extreme events, because the relationship between size and probability is important;
- the form of the reliability standard should provide information on the full probability distributions of the metrics selected to describe the system performance, for instance via augmenting expected value measures with "tail" indicators; and
- form of the reliability standard could also include risk-aware approaches that could account for a risk attitude of the decision-maker.

Previously AEMO has put forward discussion on alternatives to the current standard, to reflect that a modelled outcome of 0.002% p.a. on an average basis may disguise the true nature of reliability risk by hiding the relationship of size and probability of USE events. It is welcome that the Panel has identified these concerns and set out a desire to address them.

Suggestions AEMO has put forward have included 0.002% once every 10 years[2], which was later considered to approximate to an annual USE value of 0.0006% as established by the Energy Security Board for the Interim Reliability Measure (IRM)[3]. Further, in its submissions on the proposal for Enhanced RERT[4], AEMO discussed the relationship of size and probability and set out the idea of conditional USE, being the mean of the modelled outcomes that have non-zero USE. In the submission to the Panel's Issues Paper published earlier this year AEMO reconfirmed a desire for reliability at a level around 0.0006%.

Alignment between the means and ends

AEMO notes the Panel's statement that more than one metric may be needed to capture reliability risk. The problem with using more than one metric is when only one instrument can be applied, such as in this case regarding the Panel's determination of the appropriate reliability settings.

In a different context, where a second instrument is being considered, (such as the proposal for Enhanced RERT or setting the procurement of Interim Reliability Reserves at 0.0006%), a supplementary metric could drive a separate instrument targeted solely at tail risk. For example, the reliability settings aim to achieve 0.002% whereas the Interim Reliability Reserves are procured to achieve 0.0006%. A problem with doing this is potential to confuse the ends (which would the reliability metric), with the means (which would be the instrument, i.e. the reliability settings or use of reliability reserves). Irrespective of one's opinion of the

[1] Set out on P47-48 in the RSSR Draft Report and abbreviated here
[2] ESOO 2019
[3] National Electricity Amendment (Interim reliability measure) Rule 2020
[4] p15, The NEM Reliability Framework November 2018 - Additional information from AEMO to support its Enhanced RERT rule change proposal

suitability of different means to provide the same ends, (for example the use of out-of-market reserve to manage tail risk as opposed to simply changing the reliability settings), ideally the reliability standard should represent the tolerance to the risk of USE, by accounting for both the size and probability of USE events. It is welcome therefore that the Panel is committed to accounting for tail risk indicators in the reliability standard.

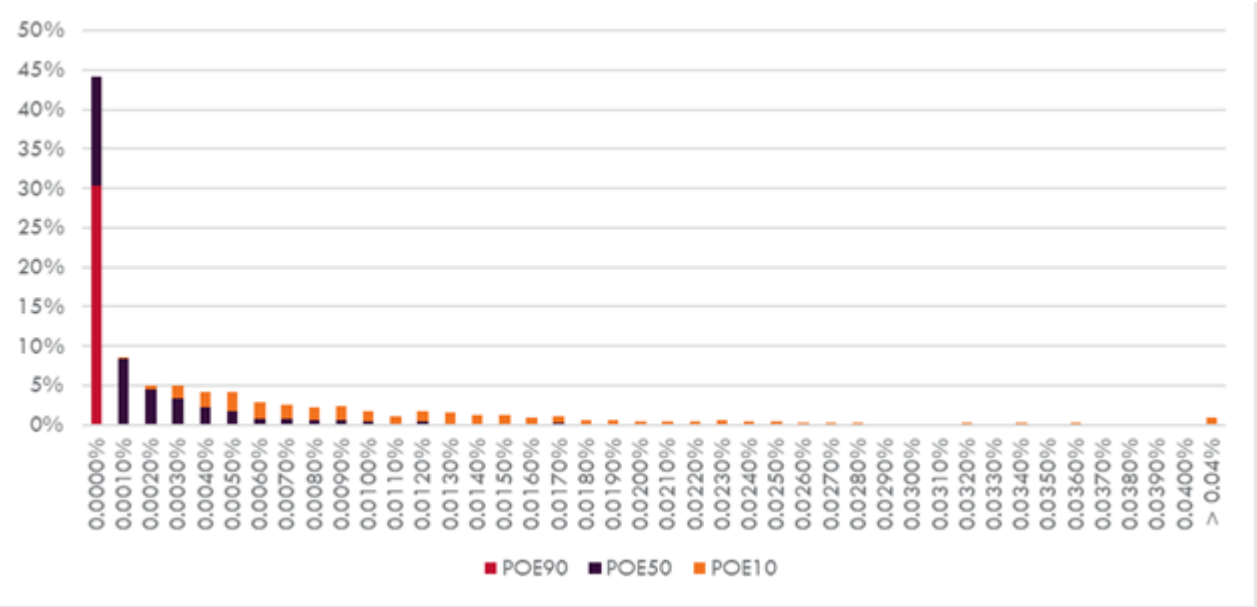
Under the strawman presented in the Draft Report, the issue of having two metrics and yet one instrument, is dealt with by applying a weighting parameter for *expected* and *conditional* USE. AEMO notes the weighting does not solve the complexity presented by having two metrics and yet one instrument, it simply transfers it into the weighting calculation. AEMO can see why the Panel may be drawn to an approach that produces one final combined metric, allowable USE, for the standard because it can be used to directly calculate the Reliability Settings.

Tail risk is not an abstract modelled concept

With respect to the need for a risk aware standard to commence in 2025, AEMO provides the following analysis from the Update to the 2021 ESOO published in April 2022. Post Eraring closure, considering only committed developments, modelling suggests a very real expectation of unserved energy. The reliability modelling is calculated for system normal conditions, which assumes almost all transmission elements are available and in service. The modelling reflects 2,200 cases and is not fully representative of the myriad of potential outcomes in the real world. In dispatching available resources, the model uses perfect foresight and does therefore not account for cumulative circumstances, or how decisions or trends made in one period can affect another, such as when where one event may lead into another, meaning the event is less random than one may expect.

In the chart below the POE90 demand case, which is a demand forecast AEMO expects to be exceeded every nine of ten years, USE is assumed to be zero, and should be disregarded. For the remaining two thirds of the simulation, being POE50 and POE10, with demand expected to exceed the forecast every five in ten years and exceeding the forecast only one in ten years respectively, the expected USE is distributed widely. For the one in ten-year demand, the modelling suggests USE is guaranteed and would most likely exceed the reliability standard. Further, demand that is forecast to be exceeded five in ten years has more modelled simulations that result in USE than it does not. This is true of all modelled outcomes, which tend to have USE.

Figure 1 NSW 2025-26 reliability outlook



AEMO acknowledges the average USE for NSW is modelled to be above the relevant reliability standard of 0.002%, rather than exactly 0.002%, and so the tail would naturally be expected to be larger, but it is the simulated observation of significantly larger USE events that is concerning. This is because to aim for an average expected USE of 0.002% is to accept that, should sufficient generator or transmission outages coincide then a significant loss of load could occur. If the distribution of outcomes was tighter AEMO would accept that a mean USE value is acceptable. For example, if the mean USE could be reasonably expected every year it would become widely understood and accepted, but this is not expected to be the case, particularly as the amount of surplus capacity in the power system erodes as capacity withdraws, and outage rates increase. As such, there is an expectation that while there may be some lucky years there is also an increasing likelihood of one calamitous one. Further, the very real possibility that the power system will not be in system normal conditions under such a circumstance, indicates that modelled tail risks underestimate the consumer impact.

It is not the purpose of this submission to prove this, because AEMO understands the Panel already has information on how the power system risks are changing from its advisor, Dr Pierluigi Mancarella, and is well summarised in sections 4.2.2 and 4.2.3 of the Panel's Draft Report. AEMO expects his insight to support the Panel's recommendations in the final report. Instead, this data has been provided to show how the abstract modelled results apply to the real power system in the forthcoming review period.

The following figure was provided to Reliability Panel members its advisor, Dr Pierluigi Mancarella. The data shows how the distribution of outcomes is simulated to widen, due to increased variability in supply. Without accounting for this increased tail risk caused by the wider distribution of outcomes, a USE standard based on the mean of outcomes may expose the NEM to very large USE events.

Figure 2 Distribution of supply, capacity margins and LOLP with increasing variable renewables

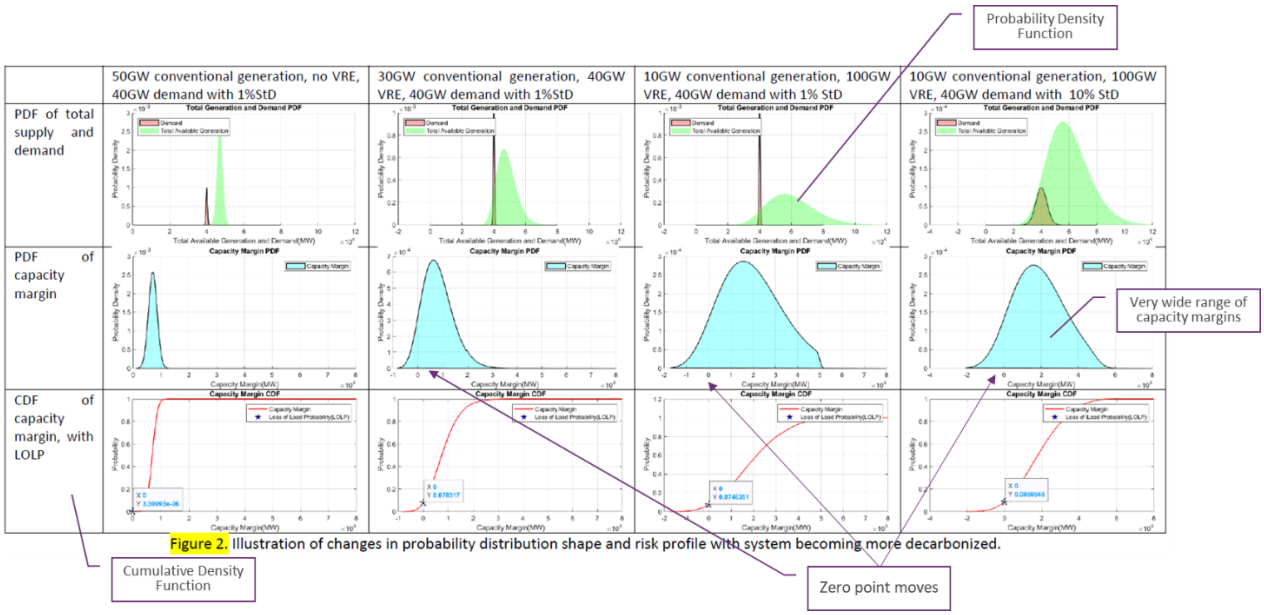


Figure 2. Illustration of changes in probability distribution shape and risk profile with system becoming more decarbonized.

Accommodating tail risk from 2025

Section 4.5.1 of the Draft Report outlines a risk aware straw person called CVaR, which is a composite reliability standard that includes a weighting parameter for *expected* and *conditional* USE.

> **BOX 5: EXAMPLE GENERAL FORM COMPOSITE RISK-AWARE RELIABILITY STANDARD.**
>
> $R_{USE} = w \cdot \text{expectedUSE} + (1- w) \cdot 95\%\text{-CVaR}_{USE}$
>
> Note: The *w* parameter reflects the weighting applying to the level of risk aversion. This should not be confused with *α* which describes the extent of the tail captured by CVaR.

The degree of risk aversion in the composite standard is dealt with through parameters of the model, namely, *α* and *w*, which are described as suitable for adjusting in response to evolving conditions without having to change form of the standard.

Although supportive of the tail risk parameter[5], AEMO considers *α*, which defines the CVaR[6], needs further research, investigation, and comparison with alternatives before being incorporated into a new standard. The time and resources available to this review may be insufficient. For example, AEMO needs to be able to report actual USE outcomes against the standard and assess the standard in Medium Term PASA and ESOO reporting. Is this simply comparing the actual and modeled values to the single composite allowable USE or will it be more complex than that?

Under this framework AEMO would consider the existing standard has a *w* of 1, which means the conditional tail metric is completely unaccounted for. Recognizing the Panel's desire to account for tail risk, yet the difficulty agreeing this, establishing the parameters, and subsequently remodeling the standard and settings

[5] P15, The NEM Reliability Framework November 2018 - Additional information from AEMO to support its Enhanced RERT rule change proposal
[6] As something like 95% (capturing the worst 5% cases) or 99% (capturing the worst 99% cases)

within the timetable of this review, AEMO suggests the obvious approach is to view the average USE modelled outcome as indicating the *maximum* acceptable standard. This means a lower USE value, could be targeted as a step in the right direction of accounting for tail risk.

Further, as discussed in the next section below, there may be opportunity to reinterpret the modelled results or to revise the starting assumptions to accommodate a lower USE value. This would allow the Panel to start to integrate tail risk for the 2025-2028 review period simply by recommending a lower USE value, and then establish a “risk aware” standard for the next review period, well in advance of modelling activities that inform the absolute value of the standard and settings.

To confirm, AEMO considers the Panel should incorporate tail risk in the Reliability Standard in some way, even if this is simply lowering the allowable USE standard from 0.002%.

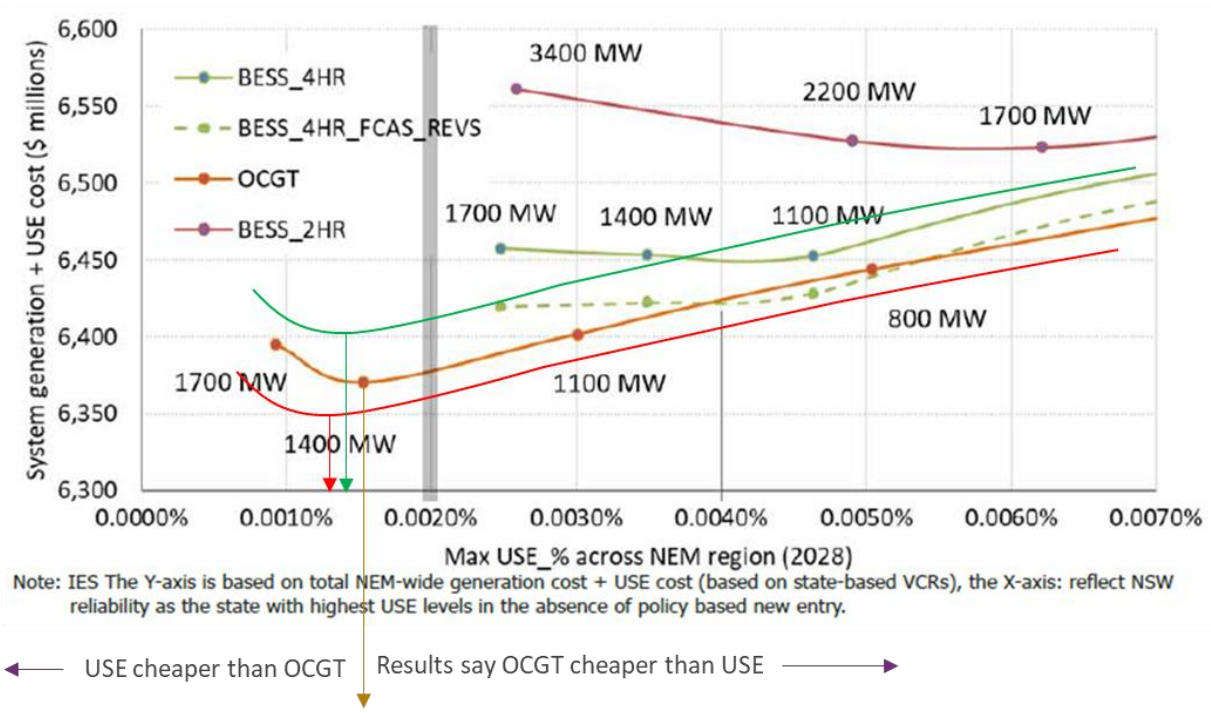
Attachment 2

Modelling results, including a need to better incorporate demand response.

The modelled results presented in the Draft Report are dependent on the starting assumptions. There is opportunity to revise and reinterpret the results. Unfortunately, the modelled results in the Draft Report provide no opportunity to accommodate tail risk without further increasing the settings, which are already presented as being too low to meet the current standard.

The following figure is taken from the Draft Report[7] and shows the modelling results to calculate the efficient level of the standard. The modelling results present Open Cycle gas Turbine (OCGT) as the most efficient technology, resulting in a level of reliability of 0.0015%, close to the 0.002% standard. AEMO has overlaid two further curves, which are not modelled results, but simply added to make the point that the cheaper the resource cost assumption (red curve) and/or the higher the assumption of consumer willingness to pay (green line) the better reliability the system can afford.

Figure 3 Modelling results, with amendments added



Source: Reliability Panel, 2022 Review of the reliability standard and settings, Draft report, 9 June 2022, amendments added

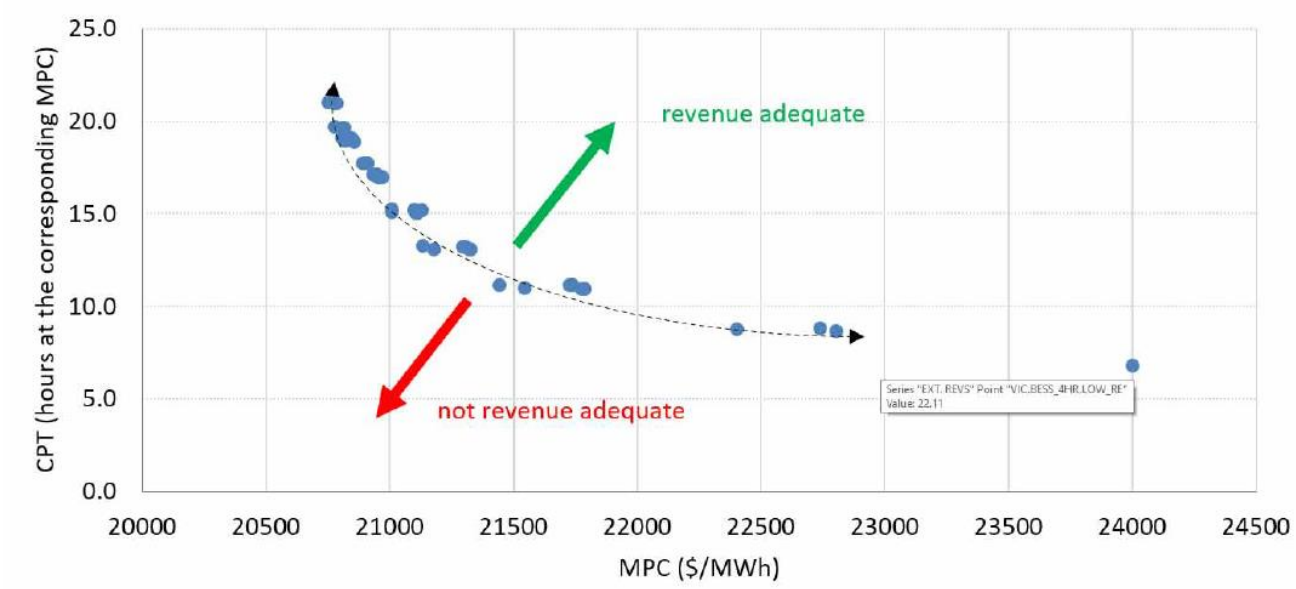
Modelling resource costs as quite expensive, such as simply adding more generating capacity, leads to the perception that a high level of USE is efficient, and the cost assumptions flow through to high reliability settings.

This is shown in the following figure 6.1 taken from the Draft Report. The Figure shows the modelling for the reliability settings, which is calibrated to provide the reliability from the efficient USE run but varies the new

[7] Reliability Panel, 2022 Review of the reliability standard and settings, Draft report, 9 June 2022

entrant plant and identifies the reliability setting combination of the Market Price Cap (MPC) and Cumulative Price Threshold (CPT) combination that ensures revenue adequacy. This is despite the reliability modelling showing OCGT as the most efficient. The figure shows the balance between reducing the CPT, and then increasing the MPC, with an "efficient frontier" being present, with the curves varying by technology depending on the cost and utilisation assumptions behind each.

Figure 4 Modelling and the concept of the efficient frontier of reliability settings



Source: IES, 2022 Reliability Standard and Settings Review - Modelling Report, Fig. 65.
Note: The points that define the efficient frontier have a total region cost within 5 per cent of the minimum total region cost point.

Source: Reliability Panel, 2022 Review of the reliability standard and settings, Draft report, 9 June 2022

The OCGT case shows why the reliability standard and resulting reliability settings are so high: the revenue adequacy test means a minimum price cap of over $20,000k only if the CPT hardly binds, yet reduce the CPT and the MPC needs to increase. The current MPC of $15,500/MWh being misaligned to the reliability standard of 0.002% is a function of the starting assumption of the cost of the OCGT and the backdrop of more challenging reliability risk caused by greater variability.

The problem with this narrative is that it seems to tell us what we already know, that investing more capital in largely idle capacity will reduce productivity and increase costs. Rather than interpret the modelling in such a deterministic manner, where the modelled outcome simply produces three numbers, USE, MPC and CPT, it is worth interrogating the data to understand the reliability challenge in terms of opportunity it may provide for new and more productive approaches to managing reliability in a system reducing emissions. Or, to look at the results another way, the USE standard and reliability settings form a *maximum* modelled outcome if one assumes the industry does largely the same as before by adding further generating capacity. This is because modelled outcomes tend to persist approaches and fail to account for innovation and improvements in productivity.

The modelling of the efficient standard, with the "hockey sticks" presented in the Draft Report show the differences in the modelled outcomes for the reliability standard are the order of 100s of MWs and 100s of

$Ms, and these are the investment decisions made at the margin, which would be terribly hard to predict with any accuracy. Further these investments may be affected by other changes to the industry, such as improvements in data, facilitation of transmission connections, interconnection, demand-side reforms, tariff innovations, etc. that may presently act as bottlenecks to the availability of cheaper resources. AEMO notes this review covers what should be a period of substantial change in the industry, with numerous regulatory changes commencing that hope to reduce costs and improve productivity.

Rather than rely too much on the modelled results, which seem to provide no opportunity to accommodate tail risk (even if it is simply reducing the USE value) without further increasing settings, AEMO would recommend the Panel revise assumptions for distributed energy resources and demand side response. Further, it should accept modelled results do not present a true picture of how the market will manage reliability risk. The Panel seeks stakeholder feedback[8] on using a higher VCR assumption than the base case. AEMO would consider this sensible, but it should be done in conjunction with revising estimates of the availability of consumers that aren't willing to pay as much and will participate either within the market or through RERT panel agreements.

Without being drawn into arguing over modelled results, AEMO considers the results tend to the high side, for both the USE standard and the resultant reliability settings. AEMO would suggest that at the MPC/CPT values the Panel has put forward[9] some accommodation of a lower USE could occur to somewhat account for tail risk. By contrast, the Draft Report has recommended an increase in price for the same level of reliability.

Although modelling is highly driven by the starting assumptions it provides a useful guide to the nature of the reliability risk. AEMO's priority is to seek a lower USE value to account, at least in part, for tail risk. Therefore, the Panel should be in no doubt that AEMO recommends a USE standard closer to 0.0006% be targeted irrespective of the means to provide for it, and the Panel should recommend the settings accordingly. Notwithstanding the previous comment on the results tending to the high side, should the revised modelling indicate a need to increase the reliability settings to provide for a lowering of the USE standard, then this should be done, (albeit AEMO hopes closer to the lower end of the range of settings put forward in the Draft Report). It is important the Panel do this, not only to ensure the market has incentive to provide reliability, but to allow the Reliability and Emergency Reserve Trader to return to a back-up role, and because the Energy Security Board is fast tracking a new capacity mechanism for 2025.

[8] P63, Reliability Panel, 2022 Review of the reliability standard and settings, Draft report, 9 June 2022
[9] MPC: $21,000/MWh to $29,000/MWh CPT: $1,359,100 (corresponding to 7.5 hours at the existing MPC) and $4,176,000 (corresponding to 12 hours at a maximum MPC of 29,000/MWh) - Reliability Panel, 2022 Review of the reliability standard and settings, Draft report, 9 June 2022

Attachment 3

Specifics on the reliability settings.

AEMO considers the Panel is correct in selecting a Market Price Cap (MPC) and Cumulative Price Threshold (CPT) combination that is not at the extreme end of either of the settings. Notwithstanding this, there is more scope to increase Cumulative Price Threshold than the Market Price Cap. The Administered Price Cap could be increased, or maybe there could be flexibility to increase it to ensure market operation during an Administered Pricing Period.

AEMO recognizes the Panel must set the CPT to ensure it does not reduce the remuneration to suppliers, and thus defeats the purpose of the MPC. The Panel's modelling, depending on the region and assumptions on the use and cost of resources, indicated that some MPC and CPT combinations suited certain technologies. It would be unwise to predict the performance, deployment of new technologies and design the price settings accordingly. If the performance, deployment of new technologies was known then there would be little need for price incentives to encourage investment. This would suggest a Market Price Cap (MPC) and Cumulative Price Threshold (CPT) combination that is not at the extreme end of either of the modelled settings.

AEMO generally supports the Panel's view of a CPT range between 7.5-12 hours and would suggest there is more scope to increase the CPT rather than the MPC. This is because a CPT of that range would clearly offer some protection to risk, as opposed to a very high CPT that is unlikely to bind at all. By contrast a CPT lower than the current 7.5 hrs appears too short and may run the risk of dissuading long duration storage, fuel capacity and even hazard tail events. For these reasons AEMO suggests there is scope to increase the CPT further than there is for the MPC.

Recently[10] the Administered Price Cap (APC) has been found to too low[11], with this encouraging plant to bid unavailable during an Administered Pricing Period. Whilst the current fuel prices may subside, forward prices for commodities remain elevated, which suggests it may take time to do so. Further, it appeared that when some plant bid unavailable because their fuel costs were higher than the APC, (despite the available compensation from the AEMC), other participants, whose fuel costs may be less than the APC, also bid unavailable. This could have been because, after other plant had bid unavailable, dispatch was then imposed on these units in a cascading effect and so these also bid unavailable. Market operations would likely have been improved by a higher APC or the ability for AEMO to judiciously increase the APC to clear dispatch. Alternatively, participants could have made plant available and relied on the AEMC compensation arrangements that are available to them. Whilst AEMO notes that providing it with the power to increase the APC during an APP may perversely encourage some generators to bid unavailable, (to try to force AEMO to increase it), it seems odd AEMO has the power to suspend the market yet none to adjust the APC.

Another option would be to increase the APC, although if the APC is set very high this somewhat defeats its purpose and starts to undermine the MPC and CPT. This would suggest some way of indexing to current fuel costs may be appropriate and, in this regard, AEMO refers to the approach taken in in Western Australia.

In the Wholesale Electricity Market (WEM), participants offer energy and ancillary services to meet real-time demand for energy. Offers are based on the cost of supply and are subject to a set of energy price limits.

[10] 12th to 15th June 2022
[11] Alinta has recently proposed a rule change recognising the issues with the current level of the APC. Amending the administered price cap | AEMC

The energy price limits are the maximum STEM price, which applies to the generation of electricity from all facilities except those using distillate as the fuel source, currently $290/MWh[12]; and the alternative maximum STEM price, which applies to generators that use distillate as a fuel source, currently $969/MWh[13].

This has the drawback of trying to administer a different price cap for one technology, yet forgetting others, and AEMO notes it would not have resolved the present issues in the NEM, with the $290/MWh being lower than the NEM's $300/MWh APC. Nevertheless, the concept of indexing to a current fuel price is appealing. Further, the WEM approach is quite complex would require detailed consideration of the regulatory instruments and roles and responsibilities to implement something similar in the NEM. In the immediate term it may be sensible to increase the APC.

In the long term any APC setting may be found wanting, which suggests more flexibility and less prescription is warranted, so the APC can respond to the circumstances that caused the CPT to have been breached in the first place.

[12] Maximum STEM Price – price cap for all non-liquid plant, which is based on the marginal cost of highest cost non-liquid (viz. 40 MW OCGT) plant. Set annually by the Economic Regulation Authority (formally undertaken by AEMO).

[13] Alternative Max STEM Price – price cap for liquid plant. Most price components set annually by the ERA, with a monthly adjustment by AEMO based on international distillate prices. 3-month average distillate price is used to adjust the fuel component of the price from the published ERA value.