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Dear Christiaan

AEMC Review of the SA Black System Event

Following a discussion between AEMO and AEMC staff on 1 October 2019 and subsequent conversations, this letter is intended to provide clarification on parts of AEMO's submission to the AEMC discussion paper - *Mechanisms to enhance resilience in the power system*. Specifically, AEMO would like to explain in more detail:

- why it considers the AEMC's proposal to address 'credible indistinct' risks is not (or not yet) an implementable approach; and
- how AEMO's proposal to redefine contingencies and expand the reclassification regime, while not providing a permanent supplementary reserve for uncertainty at present, could provide a practical and workable alternative framework for improving resilience to most indistinct risks in real time.

1. Inherent uncertainty and the n-1 (plus) approach

1.1. Likelihood of unpredicted indistinct events in normal operation

AEMO recognises that the ongoing NEM transformation will introduce different types and greater levels of uncertainty in normal system operation. The associated risks and the severity of their consequences will continue to diversify. As separately discussed with the AEMC, this is one of the key challenges being explored and addressed in the NEM post-2025 market design work with the ESB.

Section 2.3 of AEMO's submission acknowledges the reality of inherent uncertainty in the NEM at all times. Even in expected 'normal' conditions there is always a possibility, perhaps even a reasonable possibility, of significant very fast ramping or multiple disconnection events from related causes at any time.

1.2. Issues in determining a plus

AEMO understands that the AEMC's n-1 (plus) proposal is intended to give AEMO an additional tool to increase the resilience of the power system for uncertainty in 'normal' conditions, by

providing a form of reserve buffer. There are inherent difficulties and limitations in the AEMC's proposed approach to determine this buffer within the current framework. For example:

- AEMO's submission (Table 2) emphasised the breadth of supply- and demand-side sources of uncertainty which exist within the current operating environment. At this stage of the transition, further work is required to better characterise the nature and potential impacts of these sources of uncertainty.
- The use of FUM-like probabilistic measures should be avoided if there is inadequate data to draw firm statistical conclusions. The FUM's Bayesian belief model is trained on historic, observed data and considers uncertainty at the tails of the distribution – there will always be a sparsity of data points in this region which are subject to historic volatility. Given the transition of the power system and pace of change, there is a lag in the learning mechanism to reflect the current and future operating risk environment. For many arising issues, clear statistically significant empirical relationships have not emerged as yet. The accuracy of any probabilistic model (and ultimately its effectiveness and success) will be measured on a tool's ability to realistically and confidently characterise aspects of uncertainty associated with a 'credible' event. Further work is required.
- Section 2.5 of AEMO's submission highlighted key elements of how a proposed 'plus' must be considered within the regulatory framework and future market designs.[1] The need for (e.g. system or economic), and type of (e.g. commitment or flexibility) reserves has not yet been clearly articulated within the context of the NEM's current system security and reliability frameworks, including its interaction with other market services such as FCAS. It may be premature to develop a 'plus' in isolation of other system service needs where there may be an opportunity to cooptimise and minimise costs. Methods to model and approximate the economic value of reserves including the cost of holding these reserves in line with consumers' willingness to pay is crucial.
- The AEMC's approach suggests that provision of a reserve in the form of 'plus' is the primary risk mitigation to manage 'credible' variability in supply and demand. AEMO notes, however, that it cannot substitute for measures to enhance the underlying resilience of the power system through initiatives such as AEMO's proposed enhancements to primary frequency response.

These issues give rise to a likelihood that, if a 'plus' had to be determined now, it would represent a significant over- or under-provision of reserve. In the former case, the cost to the market of holding those reserves could be high. In the latter, should an unexpectedly large event occur, the tool will be judged to have failed to fulfil its purpose.

These difficulties can be overcome with further time and resources to undertake detailed technical and economic analysis and stakeholder engagement. This could then support the development, testing and automation of suitable criteria and processes. This is work which is

[1] Further work for future system service needs and changes to the NEM design should provide transparency on the pricing and procurement of these services; and consider the most economically efficient way to value, optimise, procure, dispatch and remunerate these services (i.e. through market or regulatory mechanisms).

currently being pursued by both market bodies via the ESB post-2025 market design reform. It would be premature to introduce a 'plus' criteria in the rules in isolation of this reform.

1.3. Prioritise a better system for heightened risk

AEMO considers that a simpler and more effective approach could be adopted immediately to address circumstances where there are heightened risks to the power system while the NEM post-2025 work proceeds. These circumstances can be equated with periods when, under the n-1 (plus) proposal, AEMO might have been expected to set a high 'plus' because it foresees conditions in which a very large change may result from indistinct events. In AEMO's view, however, these would correspond to abnormal (rather than normal) operating conditions, which lead to greater variability becoming credible and hence requiring additional operational management. In the short to medium term, this should provide enough flexibility to address credible indistinct circumstances when it is objectively reasonable to do so, within an established (and if necessary extended) governance framework.

2. An alternative framework

In its submission, AEMO put forward an alternative proposal that could be applied to address indistinct risks in both the credible and non-credible quadrants. This proposal draws on the AEMC's concept of protected operation, and the proposed operational response recently endorsed by the Power System Security Working Group and summarised in section 3.3.1 (Table 4) of AEMO's submission. The primary difference is that it proceeds on the basis that the indistinct risks for which protective measures are taken will have become credible in the prevailing conditions.

As described in Section 3.3 of AEMO's submission, AEMO strongly supports the concept of protected operations, and welcomes ongoing engagement with the AEMC on workable detailed design principles. These would include triggers for the application of proptected operations, and the type of actions AEMO will take, to be set out in published and consulted system security procedures.

AEMO has further refined its proposal and undertaken preliminary drafting (attached) for potential changes to rule 4.2. The drafting is only indicative and AEMO recognises it may not adequately address all issues. In summary:

- A contingency event is no longer limited to something that causes the failure or removal from service of a generating unit or major transmission element. It is redefined as an event that would be expected to result in a sudden and unplanned change in the availability or operability of generation, networks or scheduled load.[2] This allows the contingency framework to account for sudden reductions in operation, as might occur on the triggering of runback schemes or known control scheme actions.
- A credible contingency is still defined as a contingency that is considered reasonably possible in the surrounding power system circumstances. The key changes are:

[2] Another alternative for potential consideration is to reconcile the contingency event definition with the generation, network and load events in the FOS (with appropriate amendment).

- The examples of credible contingencies are removed.
- There is a clear statement that, in the absence of abnormal conditions, certain events are not to be considered credible. These are three phase faults, busbar faults (currently implied in clause S5.1.8) and multiple simultaneous disruptive events.
- The management of credible contingency events can take one of two forms depending on whether the plant at risk from the contingency can be specifically identified (i.e. distinct) or not (i.e. indistinct). Indistinct events will only be credible in abnormal conditions.

- The power system security principles will confirm that an indistinct credible contingency will be managed by taking measures to increase resilience such that AEMO expects the power system can be restored to a satisfactory operating state, even though it may not immediately return to that state – i.e. it may not 'land satisfactory'.
- The reclassification criteria will describe the criteria AEMO will apply when assessing the potential impact of various types and levels of abnormal conditions (as they do now), and also describe the nature of power system management actions AEMO may take when an indistinct contingency event becomes credible, consistent with the power system security principles. Practically, AEMO expects these actions are most likely to be, if and when appropriate and achievable, a combination of: recalling outages, reducing flows on interconnectors and other critical lines, constraining the level of at-risk generation, increasing reactive capability or increasing FCAS reserves.
- As is the case now, AEMO will issue market notices for reclassifications, which will also specify any additional actions taken or to be taken. Six monthly reclassification reporting will also continue, incorporating both distinct and indistinct events.

3. Flow-on effects and existing issues

AEMO considered the potential impact of the proposed changes on some other aspects of the rules that reference credible contingency events.

In one respect the proposed amendments do not materially change the current position, because the size of a credible contingency event is already fluid. The size of the largest credible contingency depends on power system and dispatch conditions at any time. Reclassification can and does occur regularly, potentially increasing the size of the largest normally possible credible contingency by an amount that cannot be determined in advance of the abnormal conditions occurring, because at that point it can encompass multiple events or plant at-risk. Accordingly, when other rules reference the consequences of a credible contingency event as a reference point for planning or capability assessment, it is currently not possible to ascertain the size of that contingency when carrying out that activity.

The key difference under the AEMO proposal is that, for indistinct credible contingencies, there can be no assurance that the steps taken to prepare the power system will result in it 'landing satisfactory'. Currently, the power system is expected to land satisfactory if the largest credible

contingency event occurs, irrespective of its size at any given time, but noting that this can only ever be achieved to the extent reasonably practicable in the circumstances.

We looked at the following (non-exhaustive) examples of rules that reference credible contingency events:

- 3.9.3C – Reliability standard is to include unserved energy resulting from a single credible contingency event on a generating unit or an inter-regional transmission element.
- 5.20.7 – Inertia and system strength requirements methodologies must account for the maximum load or generation shedding and stability impacts expected for a credible contingency or protected event.
- S5.1a.3 – Transient and voltage stability should be maintained for any credible contingency or protected event.
- S5.1.2.1 – Network service providers to maintain power transfer capability for credible contingency events, specified in the clause with associated assumptions.
- S5.1.4 – Network service providers to determine minimum access standards for voltage variation as a consequence of a credible contingency or protected event.
- S5.1.9 – Fault clearance times for faults that are credible contingency events.
- S5.2.5.1 - Reactive power capability sufficient to ensure all relevant system standards are met before and after credible contingency events.
- S5.2.5.5 - Generating units must remain in continuous uninterrupted operation for any disturbance caused by a credible contingency event.

In the majority of cases where credible contingency events (or protected events) are considered outside Chapter 4 of the rules, what is really contemplated is the largest identifiable (distinct) credible contingency in normal or prior outage operating conditions. This is currently done in isolated instances (e.g. clauses 3.9.3C and S5.1.2.1/S5.1.8), but not in most others. As a matter of principle, it is necessary to consider and identify what is intended in each instance. AEMO considers this clarification is necessary even if AEMO's proposed framework is not implemented.

We also identified some other potential issues and anomalies in the current framework, and encourage the AEMC to consider these in its review. For example:

- AEMO notes that the rules apply the same expectation of 'returning to a satisfactory operating state' for protected events, even though the declared management actions may not be designed to achieve all aspects of a satisfactory operating state.[3]
- The frequency operating standard provides operating tolerances equivalent to those applicable to credible contingencies for any 'generation event' or 'load event', both of

[3] Noting there is a wider frequency tolerance band for protected events, other requirements (such as voltage and stability) are not relaxed for protected events.

which could considerably exceed the magnitude of the largest credible contingency. For example, a generation event is defined in the standard to include:

> *an event that results in the sudden, unexpected and significant increase or decrease in the generation of one or more generating systems, totalling more than 50MW in aggregate, within a period of 30 seconds or less.*

As defined, this could be unlimited in size across multiple generating systems and is not qualified in terms of probability of occurrence. Yet it is to be managed to the same frequency standard as a credible contingency event.

If you have further questions or would like to discuss alternative options, please contact Kevin Ly, Group Manager - Regulation at kevin.ly@aemo.com.au or 02 9239 9160.

Yours sincerely

Peter Geers
Chief Strategy and Markets Officer

Attachment: Drafting concept – NER 4.2