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By online submission

Dear Mr Pierce

Submission to Draft Determination: National Electricity Amendment (Emergency over-frequency control schemes) Rule 2016

The Australian Energy Market Operator (AEMO) welcomes the opportunity to further contribute to the AEMC's consultation process for Rule change proposals on emergency frequency control schemes lodged by the Minister for Mineral Resources and Energy (South Australia).

If you would like to discuss this submission further, please don't hesitate to contact me.

Yours sincerely

David Swift
Executive General Manager – Corporate Development

Attachments: AEMO Submission – AEMC Draft Rule Determination- Emergency frequency control schemes

AEMO SUBMISSION - AEMC DRAFT RULE DETERMINATION- EFCS FINAL– COMMENTS ON DRAFT DETERMINATION

**Attachment: AEMO Submission in response to AEMC Draft Rule Determination-
National Electricity Amendment (Emergency frequency control schemes) Rule 2016**

Unless otherwise stated, this submission adopts the same abbreviations and definitions used in the AEMC's Draft Determination.

Executive Summary

Background

The NEM is now in an unprecedented state of transformation, as centrally dispatched synchronous generation is progressively displaced by distributed and utility scale inverter-connected, non-synchronous plant. AEMO supports the need to evolve the National Electricity Market (NEM) design to meet current and future requirements. AEMO is working with the AEMC and its other stakeholders to support the transition to a reliable, affordable and sustainable future.

One consequence of this transformation, which increasingly requires the power system to operate in ways not envisaged when the NEM were initially devised, is reductions in the resilience of the interconnected system to particular extreme events.

Risks emerging from the current transition can have very severe consequences, including black system conditions in the most extreme cases. The likelihood of these kind of events is not necessarily increasing, however their potential impacts on the power system are. The presence of risks of this scale warrant some focussed precautions being taken to limit the impact of the event.

Protected events

The existing NEM framework that guides the NEM's response to non-credible contingency events allows only very limited ex-ante action by AEMO or other parties to mitigate impacts of these events. Additionally, this framework requires any ex-ante action by AEMO necessary to contain the impacts of credible contingency events to within parameters dictated by power system security standards, notably the Frequency Operating Standards (FOS). The NEM include a mechanism that allows reclassification of a non-credible event to credible on the basis of increased likelihood of occurrence, but do not allow AEMO to take into account the severity of the consequences or apply a flexible approach to determining the level of response and associated cost.

For these reasons AEMO supports the introduction of a transparent, risk-based framework that allows the likelihood *and* consequence (rather than only likelihood) of a contingency event to be taken into consideration. The risk-based framework would then be used to efficiently determine a least cost combination of mitigating tools to satisfactorily contain the impacts of some high impact low probability (HILP) non-credible contingency events- referred to as "protected events" (PEs) once they are found to warrant management.

Emergency frequency control schemes (EFCSs) are the logical extension of traditional under-frequency load shedding schemes used to manage frequency following multiple contingencies or non-credible events. Appropriately designed EFCS, using improved communication and control technology available today, are expected to act as a central and proportionate means of containing the impacts of most PEs. Additional ex-ante measures that could be used to address the impacts of PEs, where there is evidence of a cost/benefit case to do so, include network constraints and services such as frequency control ancillary

services (FCAS) and network support and control ancillary services (NSCAS) or other non-market network support services.

Because EFCS are likely to be the preferred means for managing PEs, the regulatory framework underpinning EFCSs should be amended to dovetail with the framework established to assess potential ex-ante measures to contain PEs. This would allow these complementary solutions to be devised, costed and assessed together and provide opportunities to align with the existing network planning process in seeking the least cost mechanism to address the impacts of PEs in an open and transparent process.

The operation of this integrated EFCS/PE framework will require on-going assessment of the risks of HILP events by AEMO and NSPs. AEMO would also coordinate more substantial and frequent collaboration with NSPs in assessing the need for EFCS-type solutions to address impacts of potential PEs and other non-credible contingency events.

Frequency Operating Standards and PE Guidelines

As raised in the original Rule change request as lodged by the SA Minister for Mineral Resources and Energy, some features of the current FOS may cloud obligations for maintaining power system security. Specifically, Part B (f) of the FOS requires that the extreme frequency excursion band not be exceeded for any multiple contingency event. Read literally, this provision is unworkable, because it rests on the incorrect assumption that any multiple contingency event can be managed. AEMO interprets this as a target that informs the settings of the mechanisms that AEMO is able to use to manage non-credible contingency events on an ex-ante basis. However, currently those mechanisms are limited to automatic under-frequency load shedding (UFLS). As a critical keystone in the power system security framework set out in the NER, AEMO proposes that the application of this section of the FOS be clarified and modified to relate primarily to PEs, which would be managed through EFCSs and other ex-ante actions. Following this change and associated NER amendments, AEMO would be required to operate the power system to meet the standards that relate to PEs as well as the current standards that relate to credible contingency events, in terms of pre-emptive measures. Other clauses in the NER that provide guidance on standards for power system operation would be contemporaneously amended to also refer to PEs as appropriate.

AEMO proposes that economic assessment of the potential ex-ante measures for management of PEs would be based on PE Guidelines suitable for HILP events developed by the Reliability Panel. These guidelines would provide criteria to guide transmission network service providers and AEMO to assess a wide range of contingent risks in the network in a proper risk management based framework. They would give guidance in determining which contingencies should be declared a PE and would be consistent with the principles for assessment of PEs included in the NER. The PE guidelines would provide structure for the declaration of PEs by AEMO, which would be subject to regulatory review.

The process AEMO follows in considering non-credible contingency events for declaration as PEs should be documented in a transparent manner in a periodic PE Risk Assessment report. The public nature of this reporting process would allow input from NSPs on the technical capability of event-specific special control schemes (SCSs), which would allow ex-ante measures required to meet power system standards to be quantified and accurately costed. The links between PEs and SCSs are discussed in further detail below.

Naturally other NEM stakeholders would be able to engage with this process, providing opportunities for innovative network solutions and other non-network services to be proposed and used for PE management where a cost/benefit case exists to do so.

Emergency frequency control schemes and Guidelines

The current NER framework for EFCS includes provisions for UFLS schemes. Although not currently stated explicitly in the Rules, the purpose of these schemes are to act as a general purpose mechanism to address a variety of non-credible contingency events. Recent work undertaken by AEMO has indicated that the ability of automatic UFLS to operate as expected in avoiding a system shutdown following extreme events. General purpose EFCS such as the UFLS scheme are not explicitly driven by regulatory standards that drive a mandated level of performance.

General purpose EFCS schemes, appropriate specified, should be both proportionate and highly effective in containing the impacts of a wide variety of conceivably possible contingency events. AEMO proposes that General purpose EFCS schemes should be subject to EFCS Guidelines developed by the Reliability Panel to provide clarity on the outcomes they should be designed to achieve.

Over Frequency Generation Shedding (OFGS) and UFLS schemes should be classified under the NER as General purpose OFGS scheme and administered according to the EFCS Guidelines. Enhancements to schemes would be driven by economic assessment of the risk (both likelihood and consequence) of various non-credible power system events, and the cost of scheme augmentation.

To avoid implementation delays, AEMO suggests that the Rules contain a set of transitional or interim guidelines that can be used while the Reliability Panel establishes the first version of the EFCS Guidelines.

EFCS Risk Assessment and Special Control Schemes

It is proposed that AEMO would be responsible for overseeing maintenance of EFCS scheme capability at a NEM-wide level as part of its national transmission planning function. This would require regular publication of an EFCS Risk Assessment report based on input from NSPs. It is proposed that this EFCS Risk Assessment reporting process would act to replace current biennial review of UFLS settings that AEMO coordinates.

The EFCS Risk Assessment would consider the capability of General purpose schemes to meet the requirements as set out in the Reliability Panel's EFCS Guidelines for non-credible contingency events (i.e. for over and under-frequency events). It would also allow consideration of SCS that may be required to efficiently contain the impacts of existing and prospective PEs. It is proposed a mechanism should be included in this process that would allow AEMO, where it considers that a risk management opportunity can be addressed by an EFCS (i.e. General purpose EFCS or SCS) to declare an "EFCS Need" that NSP(s) would be obliged to respond to. It is proposed that this would take place at the conclusion of the EFCS Risk Assessment exercise or other time as required and include the associated analysis in a public planning document.

As with the PE Guidelines discussed above, the public and transparent nature of these processes will provide a level of oversight and accountability for these assessments that previous versions of the NER have not required. The provisions proposed by AEMO would require considerable collaboration and information exchange between AEMO and NSPs to ensure each of them fulfils its responsibilities.

An important feature of the combined framework put forward by AEMO is the ability for the findings of the EFCS and PE Risk Assessments to mutually inform the respective cost/benefit conclusions presented in both reporting processes. What results is an integrated

policy solution for addressing the impacts of HILP events in an economically efficient manner via the operation of the parallel and interacting PE and EFCS frameworks.

AEMO's objective in proposing these NER amendments is to support the establishment of a forward-looking, transparent risk assessment process, integrated into existing planning processes, to identify and declare PEs and to assess the sufficiency of EFCS capability in the NEM.

Differences between frameworks proposed by AEMC and AEMO

The NER amendments suggested by AEMO differ in some key areas from the AEMC's Draft Determination and Rule. Most of these differences result from the AEMC's proposal to add an EFCS objective to the NER, rather than making the objective of EFCS to maintain the FOS and other PSS standards. In order to clearly elicit the nature of the differences in approach, key strategic distinctions between the two proposals are briefly discussed below:

- i. AEMO's proposal places greater emphasis on monitoring and disclosing developing power system risks in planning timeframes while enlisting NSPs to play an active role in identifying and addressing risks, with AEMO supporting this through its national planning role.

The AEMC's Draft Rule limits NSPs to playing an implementation role for control schemes.

- ii. While we expect that only a few high risk contingencies would remain following the implementation of the general purpose EFCS, a comprehensive assessment of all contingent risks in the network needs to be made within a risk management framework. AEMO's proposal suggests the introduction of PE Guidelines, which can be subjected to periodic review by the Reliability Panel to provide clarity on the economic assessment criteria and methodology for assessment of which contingencies should be declared PEs.

The Draft Rule would see the Reliability Panel determine the Post Contingency Operating State (PCOS) of each control scheme individually, without linkages to the FOS. This approach could be administratively burdensome and does not necessarily offer a level of transparency that would allow all key affected parties to easily provide input to these processes.

- iii. AEMO proposes the use of the FOS to set frequency standards for PEs, which would require a minor clarification of what is already expressed in the FOS. AEMO regards the approach of amending the FOS to remove ambiguities relating to PSS obligations as a preferable alternative to retaining the current ambiguous wording of the FOS.

The Draft Rule requires the Reliability Panel to determine a PCOS as the target system condition for each PE.

- iv. AEMO's proposal continues the current role of General purpose control schemes relatively unchanged and suggests the development of EFCS Guidelines to ensure that General purpose EFCSs are adequately maintained, while introduces SCS as an additional targeted measure that can be deployed to efficiently meet the FOS for PEs.

The Draft Rule requires each control scheme to be managed individually without explicit linkages to the FOS. AEMO considers this unworkable as discussed above.

- v. AEMO proposes a comprehensive framework with co-ordinated parallel paths for management of PEs and EFCSs within a reporting and consultation cycle that can be synchronised with existing network planning processes.

The Draft Rule does not explicitly provide clear and iterative linkages between:

- declaration of PEs and their associated ex-ante mitigation measures;
- estimation of EFCS technical performance capability that would inform the type and cost of ex-ante measures required to contain the impact of a PE; and
- other options that may be available in the existing NSP network planning/augmentation process that could be used to efficiently mitigate the impacts of a PE at least cost.

1. Introduction

This submission is structured in four sections as follows:

Section 1- Introduction:

Background and context are covered in this section of the document, including:

- a description of existing NER frameworks for managing credible/non-credible contingency events and emergency control schemes
- the rationale for a flexible and integrated risk-based mechanism for efficient management of extreme power system events, supported by regular assessment of the need for new or upgraded emergency frequency control scheme capability

Section 2- Current and proposed NER principles:

This section of the submission highlights both existing and new principles that form important components in AEMO's proposed power system risk management framework. In terms of a response to AEMC's Draft Determination, this includes:

- existing NER principles that should be retained in any subsequent policy mechanism for emergency frequency control schemes
- new principles on emergency frequency control schemes that AEMO believes should be included in the NER in response to this Rule change proposal

Section 3- AEMO's proposed power system risk management framework:

This section provides a detailed breakdown of AEMO's proposed protected events and emergency frequency control scheme frameworks. Materials provided in Appendices A and B support this section of the submission by depicting these frameworks in operation.

Section 4-Key Differences between AEMC and AEMO proposed frameworks:

This section provides discussion on key differences between AEMC's proposed policy mechanism and AEMO's preferred framework, including a concise rationale for AEMO's proposed alternative where differs from what has been put forward by AEMC.

1.1. Context and background

It is now broadly accepted that Australia's electricity industry is undergoing rapid transformation, as large, direct-connected synchronous generation is progressively being displaced by inverter-connected, non-synchronous generation at both the utility and household level. This is changing the technical characteristics of the power system, and reducing the resilience of the power system to some types of contingency events. This in turn, is manifesting as an increase in the risk of power system disturbances and a reduction in the ability of current market and regulatory arrangements to deliver acceptable power system outcomes.

In recognition of these increased risks, the South Australian (SA) Minister for Mineral Resources and Energy lodged four Rule change proposals in July 2016, two of which relate to the management of risk through emergency frequency control schemes (EFCS). One of these Rule change proposals focussed on the risk of a black system event through high-frequency events while the other focussed on low-frequency events.

In response to the Rule change proposals, the AEMC published a Draft Determination in December 2016, setting out a framework in the National Electricity Rules (Rules) for:

- Establishing and maintaining EFCSs; and
- A new category of events – “protected events” (PEs) – for which AEMO would be required to take pre-emptive steps to avoid a severe power system disruption.

While AEMO supports some elements of the AEMC's proposed framework for EFCS and PEs, AEMO considers the approach can be significantly improved in a number of key areas including:

- consideration of PEs and EFCS within a comprehensive and ongoing risk-assessment process that is integrated into existing planning processes;
- alignment of responsibilities with current agency roles; and
- greater focus on identifying optimal solution pathways through firmer connections to other NEM processes, such as network planning and investment.

1.2. Overview- central concepts for EFCSs, PEs and contingency events

A central element of the NEM power system security framework is AEMO's obligation to maintain the power system in a secure operating state¹. This entails, in part, operating the power system so it will return to a satisfactory operating state following any credible contingency (CC) event. To achieve this, AEMO has available to it various operational mechanisms such as the use of network constraints, procurement of ancillary services and if necessary powers of intervention such as directions².

For potential non-credible contingency (NCC) events (including multiple CCs), AEMO's power system security responsibilities are limited to ensuring that sufficient load is available to AEMO and in service under automatic under-frequency load shedding (UFLS) relays to restore the power system to a satisfactory operating state,³ and to procure system restart

¹ Refer to NER clause 4.2.6

² per NER clause 4.8.9

³ Refer to NER clause 4.2.2

ancillary services to be called if all measures fail and there is voltage collapse. Otherwise, the power system security principles do not allow AEMO to take steps to manage the impact of NCCs in advance unless a reclassification is warranted⁴. If under certain circumstances AEMO considers a NCC to now be “reasonably possible”, it may reclassify it the event as credible – this might occur for example during storms or bushfires. In such cases, AEMO is required to take all the precautions applicable to credible contingency events.

Emergency automatic UFLS schemes were installed in each state decades prior to formation of the NEM. They are expected to provide some protection against a total power system shutdown upon the occurrence of a NCC by shedding up to about 60% of customer load during contingent supply deficits in an effort to prevent cascading tripping that has the potential to lead to a total system shutdown. These general purpose schemes were not necessarily designed with specific NCCs in mind, but offer a valuable backstop in arresting the frequency decline of many possible under-frequency events. AEMO suggests that any changes to the EFCS framework under consideration by the AEMC should maintain the functionality provided by these existing general purpose UFLS schemes.

There are also obligations in the NER⁵, which require Network Service Providers (NSPs) to consider NCCs in network planning. NSPs should implement emergency control schemes to minimise disruption and significantly reduce the probability of cascading failure in the event of NCCs that have the potential to cause severe disruption. AEMO understands that these obligations are not currently effective, particularly where commitment and expenditure by multiple businesses is involved. Because there is insufficient guidance as to *which* NCCs should be addressed by NSPs using control schemes or other means, and a lack of clarity about the role of network users in such measures, the provision is difficult to interpret and implement in practice.

This dichotomy of CCs and NCCs and general purpose UFLS schemes has served the NEM since market start, but may not provide for the needs of market stakeholders in the context of the current NEM transition to distributed and inverter-connected generation technologies. The following factors are drivers for consideration of a new category of events:

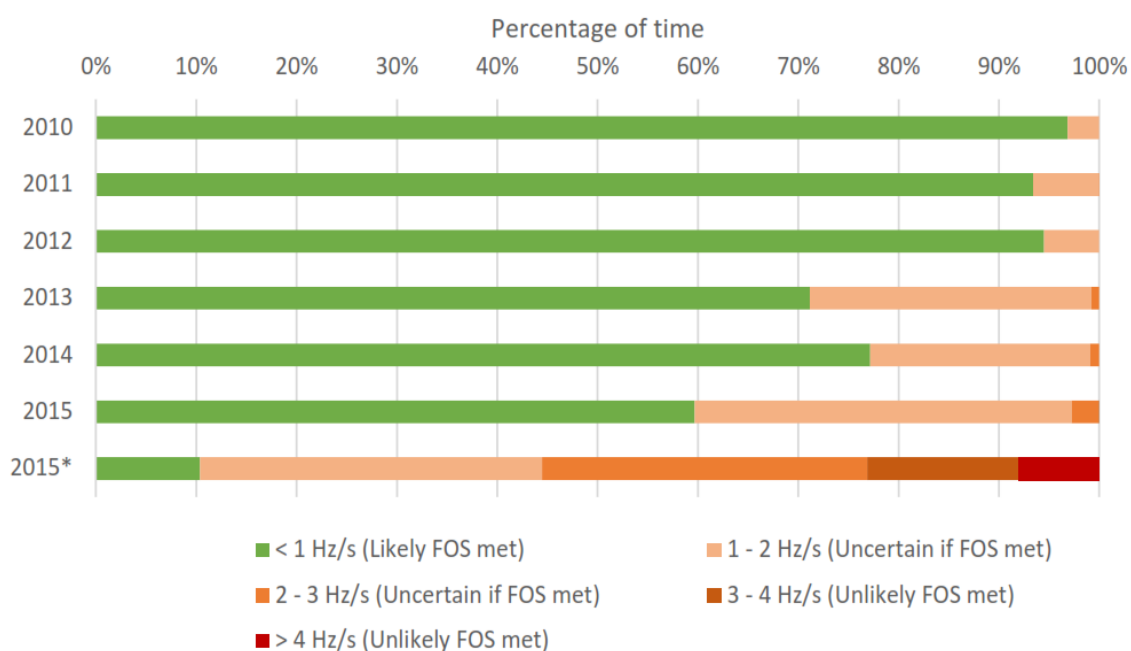
- Risks emerging from the current transition can have very severe consequences, including black system, that warrant some focussed precautions being taken to limit the impact of the event. However the current reclassification mechanism which currently is binary and transient in nature, would require a very conservative approach, and can be triggered only by the likelihood of an event and not the consequences.
 - This leaves some risks unmitigated, for example where the likelihood of an event is not increasing but the nature and extent of its impacts are.
 - The current reclassification does not generally allow for the use of limited load shedding.
 - The transient nature of reclassifications does not support solutions to address impacts events that would require investment by NSPs and other parties (e.g. control schemes).

⁴ Refer to NER clause 4.2.3A

⁵ See NER clause S5.1.8

- The general purpose UFLS schemes currently in place are progressively becoming unable to meet generally accepted risk management expectations in mitigating the impacts of NCCs, as power system inertia reduces and distributed rooftop PV increases.
 - General purpose UFLS schemes are not linked to any documented performance standard, and the Rules do not contain a comprehensive framework of accountabilities or funding for upgrading or replacement of general purpose UFLS schemes (discussed further in section 2 of this submission). UFLS infrastructure is owned, operated and maintained by NSPs.
 - While some enhancements to general purpose UFLS schemes might currently be achievable through organisation goodwill, the lack of a cohesive framework inhibits co-ordinated enhancement of general purpose UFLS schemes, and transparency of their declining capabilities (for example establishment of a NEM-wide ‘adaptive’ UFLS⁶).

Figure 1: Percentage of time SA was exposed to high RoCoF should it have separated



Current arrangements are leading to an increased risk of a black system events in parts of the NEM, where in the past control schemes would previously have contained an equivalent event to limited load-shedding, the same event can now lead to a black system under some power system conditions. One example of this is non-credible trip of the Heywood interconnector under particular conditions.

AEMO’s *Future Power System Security- Progress Report*⁷ from August 2016, showed the effects of reduced system inertia increasing the proportion of time the SA region was at risk

⁶ Refer page 12 of AEMO’s prior submission on this rule change for discussion of adaptive schemes. Available at: <http://www.aemc.gov.au/getattachment/c33bc3ad-9df3-4821-ad64-e65037b3029b/AEMO.aspx>

⁷ Figure 5, page 23- *Future Power System Security Program Progress Report*, August 2016. Available at: https://www.aemo.com.au/-/media/Files/Electricity/NEM/Security_and_Reliability/Reports/FPSS---Progress-Report-August-2016.pdf

of a system black following non-credible loss of the Heywood interconnector. This depiction of increasing impact associated with this NCC is shown in Figure 1 on the previous page

- The increasing risk does not match established expectations of when the power system will remain protected from black system events.
- Reclassification to credible events is not an appropriate response, because it would trigger a proactive conservative operating regime instead of allowing contained reactive load-shedding to occur for such low probability events.
- A middle ground between non-credible and credible contingency events can be established by identifying a subset of NCCs for which the likelihood and consequence combine to crystallise a risk that warrants mitigation following an economic assessment (i.e. an NCC that should be declared a PE). A risk oriented regulatory framework would need to be established in the Rules to drive such a mechanism.

There is increasing potential for over-frequency events, leading to a need for general-purpose emergency over-frequency generation shedding (OFGS) schemes.

- The NER do not provide any framework for OFGS schemes, which require co-operation between AEMO, NSPs and generators.
- There are very few OFGS schemes in place in the NEM, so developing such schemes would require investment in new infrastructure and development of working relationships between AEMO, NSPs and generators. For example an OFGS scheme is being developed for SA by agreement between AEMO, ElectraNet and SA generators, but the NER do not provide guidance on its design or a clear path to implementation.

1.3. The case for risk based frameworks for assessment of PEs and EFCS capability

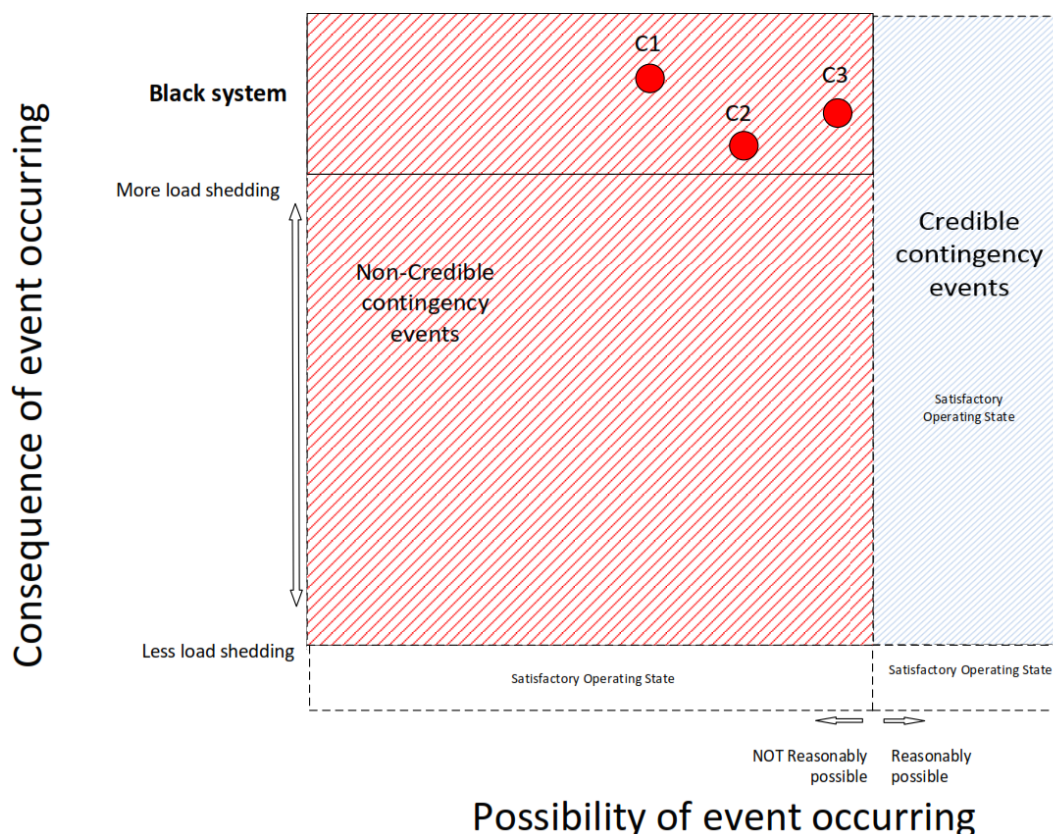
1.3.1. Existing NER frameworks

Under current NER principles:

- AEMO is required to take any ex-ante action necessary to ensure the power system will return to a satisfactory operating state following CCs, without explicit consideration of the costs of ex-ante action⁸.
- AEMO is precluded from taking any ex-ante action that may be required to maintain the power system in a satisfactory operating state following NCCs⁹. Under the current Rules, the only measure AEMO can use to mitigate the impacts of NCCs is ex-post automatic load shedding using general purpose UFLS schemes.

The current framework is summarised below in Figure 2, which has been adapted from the AEMC’s Draft Determination. The nature of the NEM is changing and the potential impacts of significant disturbances to the power system are increasing. Under the current framework, AEMO cannot take any ex-ante action to prevent events C1, C2, and C3 resulting in a Black system.

Figure 2: Current NER framework



⁸ See NER clauses 4.2.4 and 4.2.6

⁹ See NER clause 4.2.6(b)

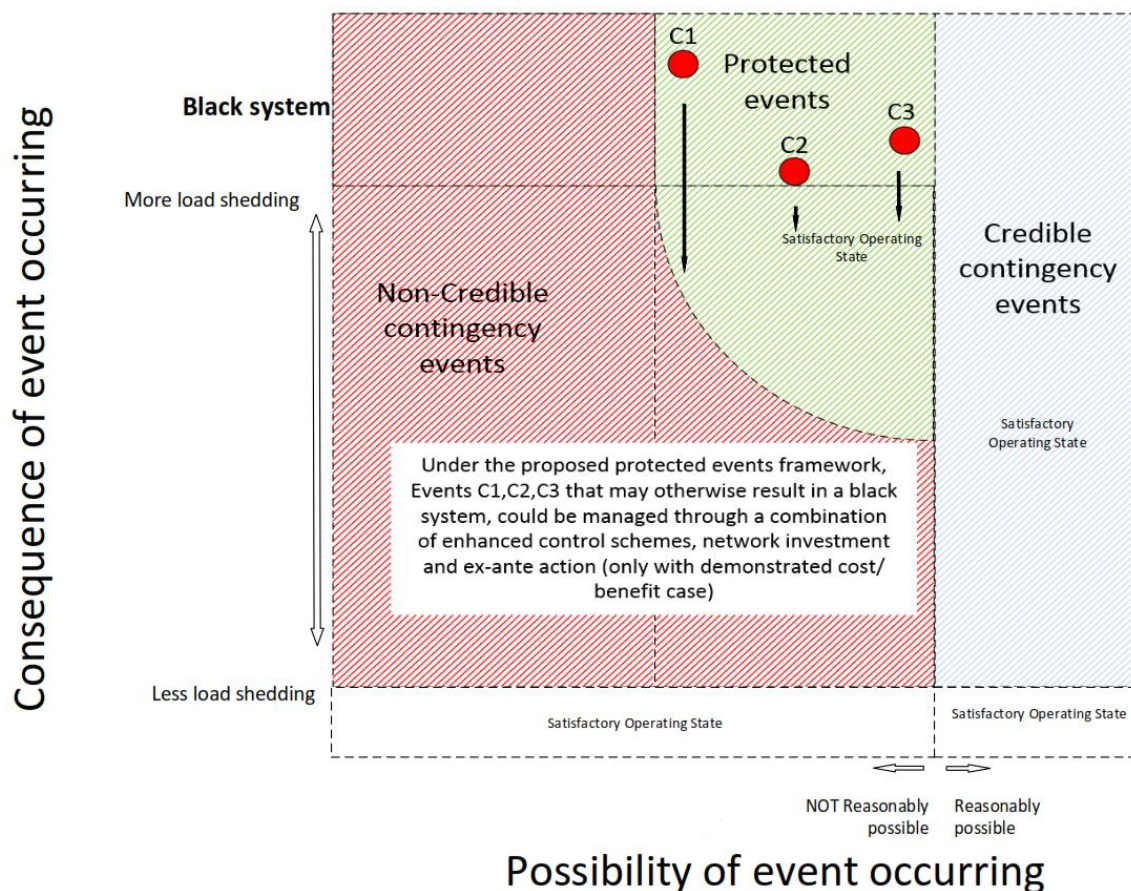
1.3.2. Protected Events

In the context of changes affecting the NEM, and consistent with the NEO, it is appropriate to address the increased impacts (rather than increased probability) of some NCCs, such as events C1, C2 and C3 in Figure 3, within a transparent, flexible, risk based (i.e. considering likelihood and consequence) policy mechanism. AEMO proposes that the impact of these events can be mitigated with a least cost combination of:

- general purpose EFCS and event-based Special Control Schemes as a preferred management measure
- the use of ex-ante measures such as FCAS/NSCAS/NMAS and interconnector constraints
- alternative network investment that may change the impact of the relevant NCC (e.g. building secondary transmission corridors)

A risk-assessment framework that allows the likelihood *and* consequence (rather than only likelihood) of NCCs such as C1, C2 and C3, will provide a robust basis for events that may have significant impacts on the NEM to be pro-actively identified and flexible managed through public reporting processes designed to identify the least cost mitigation measures.

Figure 3: Proposed NER risk-based framework



Under a bona fide risk assessment framework, a combination of probability and consequence would drive classification of a PE, rather than an increase in likelihood alone.

This concept is demonstrated by the hyperbolic (i.e. curved) line segment that forms the bottom left-hand boundary of the PE domain in Figure 3.

1.3.3. EFCS Capability

The same set of causes that are driving the increased impact of some NCCs are responsible for reductions in the efficacy of general purpose EFCSs (such as the UFLS scheme).

- There is currently no mechanism in the NEM whereby this reducing effectiveness of general purpose EFCSs is monitored, and made transparent. AEMO's identification of the declining effectiveness of the SA UFLS, as shown in Figure 1, was an isolated example of the kind of analysis and reporting that needs to take place more generally, requiring involvement from multiple parties including TNSPs, DNSPs, AEMO, and potentially also customers.
- Providing clarity on terms of review of general purpose UFLS scheme capability through transparent governance structures is a key regulatory need, to:
 - Understand the prospective performance capability of UFLS schemes
 - Identify the need for enhancements sufficiently early to affect them prior performance deficiencies having operational consequences
 - And therefore ensure that a sufficient level of EFCS capability is maintained within the power system.

1.3.4. PEs and EFCS Capability- two components of a symmetric framework

NCCs with the potential for declaration as PEs will be High Impact Low Probability (HILP) events - the same types of events that EFCSs, including GP UFLS, are intended to mitigate. HILP events of this kind are not currently managed through any specific mechanism under the Rules. Providing a means to efficiently respond to events of this kind is in the interests of all NEM stakeholders and market participants and will act to create a more stable environment for investment and risk management.

In general, properly designed EFCSs are likely to represent a least-cost mitigation pathway for management of the impacts of particular NCCs that could be declared as a PEs.

The extent of ex-ante intervention required to avoid the worst impacts of a NCC (i.e. an NCC that is being considered as a potential PE) is determined by the operational capability of EFCSs in managing these events (e.g. a faster acting general control schemes would require less throttling of interconnectors to avoid a system black condition following a potential NCC interconnector outage)

As such, assessment of costs and benefits of EFCS and ex-ante options for management of NCCs are fundamentally connected, and inform one another.

It would make sense to undertake PE and EFCS Risk Assessments in parallel and publish reporting successively to allow comment from market participants and other stakeholders including NSPs and Jurisdictions. This approach would allow NSPs and other interested parties, such as ancillary service providers to consider a broader range of potential mitigation measures for factors driving the need for EFCS or PE assessment including:

- network augmentation to remove the high operational impact of PEs through changes to network topology;
- the use of fast responding behind-the-meter load and generation resource to offer fast ramping or run back services as an alternative to schemes that only shed load.

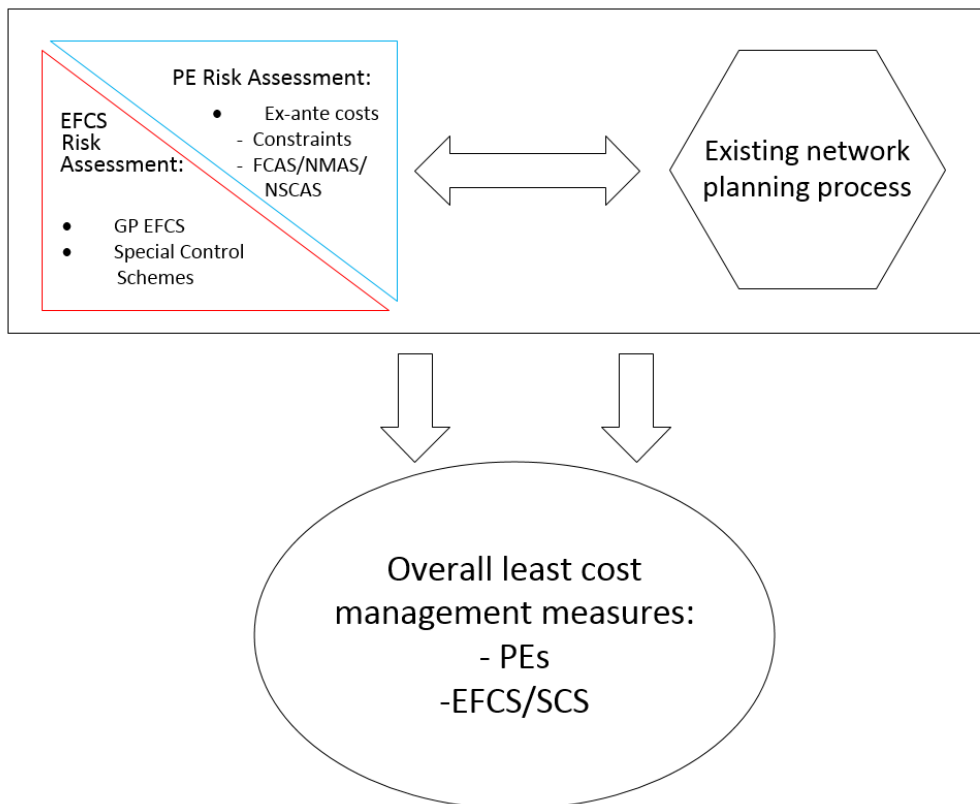
As depicted in Figure 4, interactions between the PE/EFCS Risk Assessment processes with the existing network annual planning processes, should allow all options to mitigate the impacts of a given event to be assessed and the least cost mixture of options to be selected.

This integrated, periodic and cyclic reporting process for PEs and EFCSs would allow the capability of a potential EFCS solutions to be tested then costed, and the balance of any further required ex-ante action to be assessed and costed in succession. Features of this integrated framework are discussed in detail in section 3 of this submission, and operation of the parallel reporting processes for EFCS and PEs are shown in Appendix B.

The integrated EFCS and PE mechanism proposed here is different in operation and philosophy to what is currently contained in the Rules as it:

- explicitly considers the impacts of HILP events that are not systematically recognised in current processes
- allows consideration of investment to manage power system frequency in the context of the broader planning process in order to identify economically efficient solutions.

Figure 4 Proposed integrated EFCS and PE framework



2. EFCS- Current and proposed NER principles

Any amended governance framework for EFCSs would build on existing NER principles where they have merit.

In the following sections, AEMO highlights current NER principles that should be retained in the final amended framework being consideration by the AEMC as well as new policy elements that would act to address issues driving the need for this Rule change proposal as identified by the SA Minister.

2.1. EFCS – current NER principles

Emergency Control Schemes (ECSs) can take many forms, only one of which is EFCSs. Therefore, EFCSs are a subset of ECSs.

- EFCSs can be designed by NSPs to contain power system frequency within specified bounds for specific CCs¹⁰.
- Other ECSs might include schemes designed to limit voltage deviations or prevent infrastructure overloads following extreme events¹¹. These issues are often more local in nature than extreme frequency events.

All ECSs are managed by NSPs; this requires NSPs to undertake detailed design, implementation, operation and maintenance of schemes.

EFCSs differ from other ECSs because they seek to control power system frequency, which is a function assigned to AEMO¹², whereas the other functions of ECSs are generally the responsibility of the relevant NSP¹³.

- EFCSs can be general purpose schemes such as the current UFLS scheme, or Special Control Schemes (SCS) which are event-specific schemes that are designed under S5.1.8 to manage the impacts of particular NCCs¹⁴
- The regulatory framework for management of EFCSs therefore must differ from that applying to ECSs by supporting delivery of an EFCS by NSPs that meets specifications set by AEMO in accordance with the power system security standards (the Frequency Operating Standards in particular). AEMO currently undertakes a biennial review of general purpose UFLS settings- this process could be replaced by a risk-based assessment intended to consider the broader need for EFCS solutions and the ability for parties to achieve power system security obligations
- Where possible, EFCS planning should be aligned with the timeframes and economic assessment principles of the broader network planning and development process. This would support regular consideration of EFCS measures in conjunction with other alternative network investment in a holistic and integrated fashion.

¹⁰ Refer to NER clause S5.1.10.1

¹¹ Refer to NER clause S5.1.8

¹² Refer to NER clauses 4.2.2, 4.2.5 and 4.2.6

¹³ Each NSP is obliged under NER clause 4.3.4 “use reasonable endeavours to exercise its rights and obligations in relation to its networks so as to co-operate and assist AEMO in the proper discharge of the AEMO power system security responsibilities”

¹⁴ Examples of SCS schemes proposed by SP AusNet are described in section 1.2.3 page 8 of the AEMC’s Draft Determination

2.2. EFCSs - proposed NER Amendment principles

The section introduces some new principles that form part of AEMO's NER amendment proposal. These elements are first described here and feature in the broader description of the operational framework presented in section 3 of this document and show in detail in Appendix B.

General Purpose EFCS and EFCS Guidelines

- Existing UFLS schemes would be referred to in the Rules as “general purpose” (GP) UFLS schemes. OFGS schemes would be introduced into the Rules as GP OFGS schemes¹⁵.
 - Principles would be placed in the Rules in relation to GP schemes.
- As now, the design performance GP UFLS and OFGS schemes would not be driven by any statutory standards. Enhancements to schemes would be driven by economic assessment of the risk (both likelihood and consequence) of various non-credible power system events, and the cost of scheme augmentation. This is similar in principle to the analysis carried to support most other types of network augmentation, however the analysis differs through being related to high-impact low-probability (HILP) events rather than most probable scenarios.
 - The Reliability Panel (RP) would be required to establish a set of EFCS guidelines applicable to GP schemes, consistent with the economic assessment principles in the Rules.
 - The EFCS guidelines would partially decompose the economic assessment of risk rather than leaving that for AEMO and NSPs to assess this without additional guidance. The EFCS guidelines would also form part of the oversight mechanism as they could be subject to periodic review by the RP.
 - The EFCS guidelines *may* identify specific NCCs to provide capability benchmarking for GP EFCS (a practical approach used in some international jurisdictions), or highlight process and principles that could be observed in reviewing GP EFCS capability
 - To avoid implementation delays AEMO suggests that the Rules contain a set of transitional or interim guidelines that can be used while the Reliability Panel establishes the first version through its processes.

EFCS Risk Assessment reporting and “EFCS Need” mechanism

- AEMO would be responsible for overseeing maintenance of EFCS scheme capability at a national level as part of its national planning function. This would require regular publication of an EFCS Risk Assessment report based on input from NSPs. It is proposed that this EFCS Risk Assessment report would act to replace current biennial review of UFLS settings that AEMO coordinates. The new EFCS Risk Assessment would act as a transparent assessment process that aims to identify new and emerging risk not contemplated by current EFCS schemes. The EFCS Risk Assessment would:

¹⁵ AEMO is in broad agreement with the principles for proposed NER Amendments covering OFGS schemes as set out in section 3.4.5 of the DD (p 34-35)

- Consider the capability of GP schemes to meet the requirements as set out in the RP's EFCS Guidelines for NCCs (i.e. for over and under-frequency events).
- Consider the capability of SCS and GP schemes to meet the requirements for CCs and *existing* and *potential* PEs (see section 1.3.4 for discussion of links between PEs and EFCSs)
- Require considerable collaboration and information exchange between AEMO and NSPs to give effect to the responsibility of both parties.
- Allow AEMO, where it considers an NSP has identified but not addressed a risk management opportunity, to disclose this as an "EFCS Need" and include the associated analysis in a public planning document.
- Allow NSPs the opportunity to address the "EFCS Need" disclosed by AEMO. In order to minimise on-going risk exposure of the power system, it may be prudent to include a mechanism for a suitably placed party to take steps to compel implementation of schemes to fulfil the "EFCS Need" if an NSP fails to act in reasonable time.
- Support a governance framework akin to the current "NSCAS gap" process managed by AEMO through the NTNDP. As in the NSCAS process, transparency and stakeholder input are key considerations in rendering the framework serviceable.
- Support costing of any ex-ante measures completed as part of a PE Risk Assessment (see section 1.3.4 for further discussion), by providing input on scheme performance capability and allowing the balance of actions required to maintain the power system to be estimated. The level of ex-ante action that a control scheme could offset would be able to be considered when undertaking economic assessment of upgrades to GP schemes or event-specific SCSs.

NSP Planning and implementation

NSPs would be responsible for maintaining and upgrading GP schemes:

- Tracking of GP scheme capabilities, and analysis if the risks they are expected to be capable of covering (and not covering) into the future would become part of the Annual Planning Report (APR) or similar document published by each NSP. This assessment of GP scheme capability would be informed by the EFCS Guidelines, and reported in AEMO's EFCS Risk Assessment
 - This annual planning process would aim to identify increasing residual risks.
 - Where opportunities arise to economically modify a GP scheme, or to establish a new one, that opportunity should be weighed up against other network augmentation options being considered as part of the planning process (e.g. potential installation of synchronous condensers for system strength could improve operation of an existing GP scheme).
 - Proposed courses of action, in response to declaration of an "EFCS need", including GP scheme modifications, would be identified based on the economic assessment. Investment in GP and SCS schemes would be subject to the Regulatory Investment Test (RIT) process as is already the case for other proposed network investment. It is anticipated that the cost of control schemes

would be materially lower than alternative network infrastructure in mitigating the risks posed by NCCs/PEs.

- The design and development of any SCS under consideration to address the impacts of a PE will be affected by the capability of existing or amended GP EFCS such as the current automatic UFLS scheme. For this reason, development of any new SCS should be considered in tandem with the potential upgrade or augmentation of GP EFCS (e.g. the potential installation of an ‘adaptive’ UFLS in a region), in order to achieve the desired network outcome at least cost.
- Mechanisms that would allow NSPs to expedite cost recovery following declaration of an “EFCS Need” are an important element to consider in making this framework functional. The current 5 year cycle for regulatory proposals by NSPs may be too long for the need for identified EFCS projects to be apparent in the beginning of the investment cycle. For this reason a fast cost recovery mechanism may be required, at least as a transitional measure, to ensure that EFCS schemes can be implemented and upgraded in a timely manner and thus minimise risk exposure of the power system.

The processes described above aim to transparently drive evolution of GP EFCSs/SCS where appropriate, and provide clarity as to risks they are capable of mitigating as well as those they are not capable of mitigating. These outcomes are not provided by the current framework as contained in the NER.

3. Proposed power system risk management framework- EFCS and PEs

Key elements of the proposed framework for PEs and EFCSs are set out below and build on the thinking presented in section 2 on principles for EFCS governance.

A summary of the main Rules and standards changes required for this framework is presented in **Appendix A**.

A detailed flowchart depicting the interacting parallel framework described in sections 3.1 and 3.2 is shown in **Appendix B**

3.1. PE Framework

This subsection provides detail on the full series of steps in AEMO's proposed PE framework, building on the flexible risk-based mechanism introduced in section 1 and some of the policy components introduced in section 2.

3.1.1. Standards

Rather than requiring determination of a "post-contingency operating state" (PCOS) for each PE, as proposed in the AEMC's Draft Determination, AEMO proposes that the Frequency Operating Standard (FOS) be modified by the RP to contain fixed frequency standards for PEs. This would appear to be a relatively minor change to the current FOS.

- The FOS is currently deficient in that Part B (f) requires that the *extreme frequency excursion band* not be exceeded for any multiple contingency event. This provision is clearly unworkable in its current form, because it rests on the assumption that any multiple contingency event can be managed. However, the provision could be readily modified to relate exclusively to managing protected events through EFCSs and other pre-emptive actions. This is arguably consistent with the original intent of the *extreme frequency excursion band*.
- The definition of satisfactory operating state would be modified to link to the more relaxed standards in relation protected events.
- The management objective for each PE would therefore be to maintain the power system in a satisfactory operating state¹⁶ following its occurrence (as shown in Figure 3 in section 1 of this submission).
- Any necessary changes would be made to other standards in the Rules, such as voltage standards, to ensure they relate appropriately to PEs¹⁷.
 - This could be done by AEMC as part of the current Rule change
- AEMO would then be required to operate the power system to meet the standards that relate to protected events as well as the current standards that relate to credible events.
- At inception of this framework, there would initially be no PEs, but as they are declared, they would inherit the frequency (and other) system security standards.

¹⁶ This would require including protected events with credible contingency events in NER 4.2.4(a)(2)

¹⁷ For example, NER S5.1.8 and S5.1.10.1

3.1.2. Protected events- a risk management framework

- Protected events would be established in the Rules as a new category of events in NER 4.2.3.
- In general, a NCC event could be classified as a protected event if the risk associated with its occurrence is found to be high enough to warrant mitigation, given the relative benefits and costs of doing so.
 - Risk would be the combined effect of likelihood and consequence of the event. For example, if the non-credible trip of the Heywood interconnector was being considered as a PE, the likelihood of the event might not be changing, but the consequence might be increasing with time, potentially leading to a black system when the event occurs in the future, but not in the past.
 - Mitigation would be through enhancement of general purpose control schemes, establishment of special control schemes (SCS) and / or ex-ante operational measures such as network constraints and the use of ancillary services. These are both discussed below.
 - The Rules would contain principles to be used in declaring protected events.

PEs would be declared by AEMO, under a risk management framework based on principles contained in the NER, and potentially also a set of PE criteria or guidelines determined by a body such as the Reliability Panel.

- The risk-management framework in the NER would require both plausibility and consequence of an event to be primary considerations in declaring a PE. Some principles, and perhaps an objective, would also be placed in the NER to guide decision-making by the RP, AEMO and NSPs.

3.1.3. PE Guidelines

- The RP would establish and maintain guidelines for AEMO in the declaration of PEs, including cost/benefit criteria for the assessing the use of ex-ante levers to manage a given PE. These PE guidelines would be consistent with the PE Principles included in the NER. A key aim of this should be to put a structure around the declaration of PEs by AEMO, and keep this policy structure under review.
 - This is consistent with other roles of the RP that involve trade-offs between cost and risk – e.g. reliability standard, reliability settings, SRS, guidelines for SRAS sub-networks, RERT guidelines
 - The PE Guidelines developed by the RP would provide guidance on the use of tools such as market modelling to inform the NPV of declaring a PE, taking into account the probabilistic benefits of avoiding disruption, and the cost of implementation including market constraints and service procurement. AEMO and NSPs would be well placed to derive technical input on potential costs such as ancillary services or EFCSS.
 - The AEMC could establish an interim guideline as part of the rule change to avoid start-up delays while the RP does its first full assessment of these Guidelines.

3.1.4. PE Risk Assessment reporting

- Declaration of PEs by AEMO would occur with sufficient notice to allow industry to adapt beforehand, and to allow countermeasures such as control schemes to be put

in place beforehand. For these reasons, a declaration of a given event or set of events as a PE would come after industry consultation and in-depth analysis in collaboration with NSPs to fully understand risks (both probability and consequence) and options for remedial actions (including estimates of costs for ex-ante levers). It is proposed that this could be achieved through a periodic PE Risk Assessment report prepared by AEMO in conjunction with NSPs to assess a range of prospective PEs and be publicly available to facilitate consultation.

- AEMO would be required to identify and track power system risks that may not be adequately mitigated by GP EFCS schemes. This would be part of AEMO's oversight process through the periodic publication of a PE Risk Assessment report.
- The PE Risk Assessment report would consider candidate events for declaration as protected event(s) where it seems feasible that the cost of mitigation is exceeded by the probabilistic cost of the risk.
- AEMO would transparently track the risk and mitigation options through its planning process, and would take inputs on the costs and performance potential of EFCSs from reporting completed for the EFCS Risk Assessment report (see Appendix B for more clarity on interaction of these two frameworks)
- The EFCS/PE Risk Assessments would receive significant stakeholder input to ensure that they are reasonably representing risks and costs of action. If it is clear that there is a sufficiently robust economic case, AEMO would make the declaration.
- Following the PE Risk Assessment process, if it was decided that a prospective PE may warrant inclusion in the register of PEs, AEMO would develop a 'PE Management Proposal' for consultation detailing the nature and cost of ex-ante operational measures to manage the event, informed by assessment of EFCS capability conducted with NSPs (refer to flowchart in Appendix B).

3.1.5. Declaring a PE

- To the extent possible, declaration of a PE would be a stable, longer-term decision, with adequate notice to the market via the periodic PE risk/merit assessment process. The periodic process of PE Risk Assessment reporting is intended to influence both operational and investment decisions by NSPs and the competitive market sectors in a similar way to current process for these parties to consider investment in order to contain the impact of credible contingency events.
 - One such investment decision could be the installation of EFCSs. As discussed in section 3.2 a similar periodic risk/merit assessment be conducted for EFCSs, coordinated in such a way as to allow the outcome of PE merit assessment to feed into consideration of potential EFCSs solutions.
 - EFCSs would be linked to PEs, by making EFCSs part of the means of meeting the standards for PEs.
 - Depending on the event, declaration of a PE might trigger the design and implementation of a new event-based SCS EFCS or upgrade of existing GP EFCS capability such as an adaptive UFLS.
 - NSPs would be responsible for establishing any SCS linked to the declaration of a protected event.

- This is consistent with current Rules process, where NSPs are responsible for control schemes on their network, most of which they establish themselves as non-network options.
- The functional design of the SCS would be specified by AEMO as part of an “EFCS need” declared in an EFCS Risk Assessment (as discussed in section 2.2) and in effect form part of the PE Risk Assessment process. This is consistent with obligations to maintain power system frequency being AEMO’s responsibility.
- Any declaration of a PE by AEMO would invoke the standards previously determined by the RP (FOS) and AEMC (in the NER).
 - This avoids the need for determination of a PCOS as proposed in the AEMC DD. However, if this approach proves to be too inflexible, the framework could include potential for the determination of an alternative PCOS on an exception basis. This option adds significant complication though and might best be avoided in the first instance.
 - The enlivening of declaration of an event as ‘protected’ might be linked to a future event such as finalisation of a SCS, so as to not trigger obligations to maintain the power system in a satisfactory state for PEs while there is no cost effective means for doing so.

3.1.6. Implementing a PE Procedure

Unlike operation of the GP EFCSs, where schemes are not designed to maintain the impacts of all possible NCCs (as discussed in section 1.2), the power system would be expected to survive protected events, albeit potentially with a significant disruption such as controlled load shedding.

PEs would therefore be integrated into the NEM power system security framework so their outcomes are subject to statutory standards.

- Inclusion in the power system security framework would mean that obligations to maintain the power system in a satisfactory operating state would be similar for PEs and CCs, however:
 - Any ex-ante action necessary to maintain a satisfactory operating state for CCs must be taken irrespective of the potential market impact.
 - Obligations for management of PEs to ensure return to a satisfactory operating state under the proposed NER amendments would be met through a mixture of enhanced control systems, network investment and ex-ante action only where there was a clear and transparent demonstration of cost/benefit of ex-ante action via the proposed periodic PE/EFCS Risk Assessment process
 - Any SCS established for a protected event would be the main mitigation measure. AEMO’s operational responsibilities would effectively be to ensure the power system is operated in a way that does not exceed the capabilities of that special control scheme.
- The FOS would be modified to specify a frequency band within which the power system must be maintained for protected events. This would be a broader band than for CC events, to allow for special control schemes to operate and potentially shed load. Note that the technical specifications for PEs and CCs in the FOS would be

different, allowing a less stringent standard to be applied for PEs (e.g. some load shedding in all NEM regions).

3.1.7. Framework governance and PE Guideline review

- It is important that a framework such as this has adequate independent checks and balances in place to monitor whether it is meeting its objectives.
- The RP would set guidelines that AEMO must follow in assessing and declaring PEs.
- The RP could be required to monitor and assess the effectiveness of the overall framework as part of its Annual Market Performance Review (AMPR).
 - This is consistent with other monitoring and reporting functions currently carried out by the RP – in relation to forecasting and market interventions.
 - This would also allow the Panel to recommend any changes it deems relevant to the EFCS Guidelines and PE Guidelines it has issued.

This approach puts the PE framework under constant oversight by the Reliability Panel, which is an appropriately skilled independent body with an existing annual market review role. Any need for changes to the mechanism can be driven by the Panel through the AMPR, its PE Guidelines, or if considered necessary through a Rule change.

This is consistent with other processes for which the Reliability Panel provides guidelines, such as Reviewable Events, RERT Guidelines, and guidelines for determination of System Restart Electrical Sub-Networks.

3.2. Proposed AEMO EFCS Framework

This subsection provides a description of the full series of steps in AEMO's proposed EFCS framework and builds on the existing and new NER principles discussion section 2.

3.2.1. EFCS Risk Assessment

- The Rules would require AEMO to provide oversight and coordinate functional design of EFCSs (both event-specific and general purpose schemes designed for PEs) across the NEM as an extension of its existing frequency control responsibilities
- In doing this, AEMO would convene a collaborative process between NSPs.
- It is proposed that this be achieved through a periodic EFCS Risk Assessment process coordinated by AEMO with the input primarily coming from NSPs. This would replace the existing biennial review of automatic UFLS settings and act as a broader risk-based assessment of the EFCS capability, including assessment of the need for SCSs and considerations for the upgrade of GP EFCSs (i.e. UFLS, OFGS)
- This periodic EFCS Risk Assessment would be coordinated with the proposed annual PE risk assessment in order to:
 - allow assessment of the merits of an EFCS to manage a prospective PE
 - allow an estimate of ex ante solution costs to be developed by establishing the level of intervention required to maintain the FOS given the underlying performance capability of potential EFCS solutions

An important aim of this collaboration between AEMO and NSPs would be to optimise the need for and design of any new EFCS, with the use of ex-ante measures and other network infrastructure and services to meet the range of relevant standards including the FOS. This

process would be transparent, providing opportunities for NEM stakeholders to be informed and engage with issues being considered.

3.2.2. “EFCS need” mechanism

- A key feature of the NER framework proposed by AEMO is the ability for AEMO to declare an “EFCS Need” following the EFCS Risk Assessment, which an NSP must respond to through a collaboration with AEMO. An “EFCS Need” could be declared to address a need for a SCS to mitigate the impacts of a proposed PE, or for the upgrade or augmentation of GP EFCS capability based on the EFCS Guidelines.
- After an “EFCS Need” is identified AEMO, following a consultation with relevant NSP(s), would determine the functional specification of the EFCS and may provide advice on a range of feasible solutions (e.g. a combination of GP EFCS capability and an SCS) that are likely to deliver the desired outcome at least cost.
- Once the functional specification of an EFCS is determined by AEMO, the responsibility for detailed design and installation would lie with TNSPs and DNSPs.
 - This could include upgrade of an existing ‘general purpose’ EFCS, or development of a new event-specific SCS scheme
 - Once the range of feasible design solutions is identified, the NSP would present a case to the AER for approval for the optimal solution. This could take place using existing current NSP revenue recovery processes, or an expedited/transitional approach if existing mechanisms are likely to prove unsuitable.
 - At this stage, the EFCS would become a firm element in the planning process, including APRs and the NTNDP
 - Effectively, this would encourage assessment of options to mitigate prospective and declared PEs as part of the assessment of network augmentation in general, and that EFCSs be added to the other control schemes that NSPs already routinely consider as options for capital investment (e.g. for voltage control).
 - PEs and EFCSs, to the extent they have been disclosed as potential future requirements, could therefore be considered together with other potential investments as part of each NSP’s APR process.
 - The current framework needs modification to provide for AEMO to set the functional requirements of EFCSs following collaboration with NSPs in the proposed periodic PE/EFCS risk assessment processes
 - In arriving at the functional specification of an EFCS, AEMO would be required to not only collaborate with NSPs but also NEM stakeholders as a whole, because the decision will impact those parties
 - Where possible, the approaching need for a new EFCS could be foreshadowed in AEMO’s NTNDP. It could also be foreshadowed as part of assessing a PE in the annual PE Risk Assessment process
- As discussed earlier in this submission, to avoid delays in establishing a new EFCS, there might be a need for regulatory changes to provide for support in relation to expedited cost recovery by NSPs.
- In considering the options available to it, a NSP would take the same approach it does now, by applying a RIT-like process to the options to reveal the NPV of each

option. For each option being assessed, the potential for load-shedding and the nature of the ex-ante operational measures being used by AEMO to meet PE the standards would be key inputs to the assessment.

- Interaction would be required between AEMO and the NSPs in relation to the assessments.

3.3. Observations on AEMO's proposed framework

- AEMO's proposed framework for management of PEs and EFCSs provides an iterative integrated framework that connects together the FOS, CCs, PEs and NCCs, in a manner that should serve to advance the NEO.
- Declaration of PEs is based on guidelines set by the RP, which are presumed to be relatively stable, but which are kept under regular review
 - The declaration of PEs takes into account the consequences of the event as well as plausibility in a robust risk assessment framework
- Declaration of the need to upgrade GP EFCS by AEMO will also be based on guidelines set by the RP.
 - This will act to address the ambiguities of the current framework and interpretation of NER clause S5.1.8 (i.e. the question of *which* NCCs are to be considered by NSPs in network planning).
- The proposed framework provides for clear delineation of responsibilities between NER, RP, AEMO and NSPs, with those roles remaining consistent with current skills and roles.
- AEMO's proposal treats EFCS in a similar way to other network control schemes, and provides for optimisation across the full range of network investments.

4. Key differences between AEMC and AEMO proposed frameworks

The AEMC and AEMO have spent considerable time discussing details of possible frameworks for the management of EFCS and PEs over the last few months. AEMO's proposed framework as presented in this submission builds on these discussions and the thinking presented in the Draft Determination to put forward a set of measures that AEMO believes will be more efficient and effective to implement.

The NER amendments suggested by AEMO differ in some key areas from the AEMC Draft Determination. Most of these differences result from the AEMC's proposal to add an EFCS objective to the NER, rather than making the objective of EFCS to maintain the FOS and other PSS standards.

These and other key differences are discussed briefly below to provide a concise rationale for AEMO's proposed alternative.

4.1. Role of NSPs and integration with network planning

AEMO's proposal places greater emphasis on monitoring and disclosing developing power system risks in planning timeframes. Linked to this, AEMO's proposal places greater emphasis on NSPs playing an active role in identifying and addressing risks, with AEMO supporting this through its national planning role.

- The AEMC's proposal limits NSPs to playing an implementation role for control schemes.

4.2. Determination of standards for PEs

AEMO's proposal uses the FOS to set frequency standards for PEs, which is a minor clarification of what is already expressed ineffectively in the FOS. AEMO regards the approach of amending the FOS to remove ambiguities relating to PSS obligations as a preferable alternative to retaining current ambiguous wording of the FOS

- AEMC's proposal requires the RP to determine a "Post Contingency Operating Standard" (PCOS) as the target system condition following a PE for each PE proposed by AEMO based on:
 - Description of the nature of the PE and consequences if it were to occur (e.g. System Black conditions)
 - A proposed range of PCOSs that are achievable, based on likely market conditions at time of the PE and capability of existing EFCS
 - Information on the nature and cost of ex-ante mechanisms that can reduce the impact of the PE (ancillary services, market constraints)
- Repeating this process may prove to be administratively burdensome.

This element of the AEMC's current proposal is likely to create insurmountable difficulties in estimating the costs of managing a PE. AEMO would be unable to propose a PE and estimate its associated costs in the absence of PCOS, because the target PCOS itself will determine the cost of managing the PE.

4.3. Role of PE Guidelines

AEMO's proposal suggests the introduction of PE Guidelines, which can be subjected to periodic review by the RP to provide clarity on the economic assessment criteria and methodology for assessment of PEs.

- The AEMC proposal suggests amendments to the NER that would see the RP determine the PCOS of each control scheme individually, without linkages to the FOS. This approach could be administratively burdensome and does not necessarily offer a level of transparency that would allow the current roles of parties to easily provide input to these processes.
- The AEMC's proposal does not explicitly suggest a robust risk assessment criteria based on probability and consequence for each PE. Instead, It appears that the RP would assess the merit of each possible PE in a manner that is currently unspecified
- The approach of including these obligations in the Rules themselves, would not necessarily allow the easy re-assessment of principles guiding declaration of PEs to be progressively refined by the RP based on operation experience of the framework.
- It is AEMO's view that the role of setting guidelines for PE declaration and analysis/assessment of risks from HILP events better aligns with the existing role of RP in relation to other policy frameworks, including Reviewable Events, RERT Guidelines, and guidelines for determination of System Restart Electrical Sub-Networks.

4.4. Role of EFCS Guidelines

AEMO's proposal continues the current role of GP control schemes relatively unchanged and suggests the development of EFCS Guidelines to ensure that GP EFCSs are adequately maintained, while introduces SCS as an additional targeted measure that can be deployed to efficiently meet the FOS for PEs.

- As detailed in 4.2, the AEMC proposal manages each control scheme individually without explicit linkages to the FOS. AEMO considers this unworkable as discussed above.
- This approach does not draw out the role and function of GP Schemes in a manner that provides clear and flexible guidance (due to the potential for the EFCS guidelines to be reviewed) on how they should be operated in order to ensure that they will be maintained

4.5. Integration of PE/EFCS frameworks

AEMO proposes a comprehensive framework with co-ordinated parallel paths for management of PEs and EFCSs within a reporting and consultation cycle that can be synchronised with existing network planning processes

- The AEMC's proposal does not explicitly provide clear and iterative linkages between:
 - declaration of PEs and their associated ex-ante mitigation measures;
 - estimation of EFCS technical performance capability that would inform the type and cost of ex-ante measures required to contain the impact of a PE; and

- other options that may be available in the existing NSP network planning/augmentation process that could be used to efficiently mitigate the impacts of a PE at least cost.
- Without interaction of estimated costs for EFCS schemes and ex-ante action from the two frameworks, it is not clear how it can be transparently demonstrated that the proposed mitigation strategy for PEs is the least cost solution or most efficient overall option.
- Further, unless there is reliable and firm estimate of EFCS scheme performance capability, it is difficult to gauge the level (and costs) of ex-ante intervention required to avoid a black system.

APPENDIX A: PROPOSED NER/STANDARDS AMENDMENTS



STEP 1

AEMC- NER Amendments:

Emergency Frequency Control Schemes (EFCS):

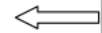
- This proposal is intended to establish a new symmetric framework that would **supersede** the existing UFLS framework and provide mechanisms to address both under and over frequency events
- This framework is intended to build on and expand the principles for good industry management set out in S5.1.8
- Clarify the objective of under frequency load shedding (UFLS) as a general purpose frequency control scheme intended to contain the impacts of NCCs/PEs
- Establish Rules basis for OFGS, as a general purpose control frequency control scheme intended to contain the impacts of NCCs/PEs including obligations for review, implementation and cost recovery
- Augment existing network planning framework to establish governance and annual review of EFCS (or as needed), consistent with existing framework for EFCS governance (which is managed by NSPs). This includes the ability of AEMO to declare an "EFCS Need"
- Align and complete remaining elements of broad framework in NER relating to load shedding and control schemes and support establishment of EFCS Guidelines by the Reliability Panel
- Add obligation for NSPs to observe an "EFCS Need" if declared by AEMO

Protected Events (PEs)

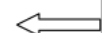
- Add obligations to observe PEs to S5.1.8 and S5.1.10.1 etc (clauses that define NSP obligations for planning to maintain stability in the network under contingent conditions)
- Define PEs in 4.2.3 (where CCs and NCCs are defined) rather than in 4.2.3A(the section on reclassification)
- Define the target in management of PEs to maintain the power system in a *satisfactory operating state* (i.e. include protected events in 4.2.4 a(2) and in an amended FOS that would include a target frequency band for PEs)
- Include provisions for PEs to be temporarily reclassified as CC where likelihood of occurrence has increased
- Include obligations for annual PE review process to be coordinated with the EFCS review process
- Clean up and polish disparate elements of broad framework in rules regarding obligations for NCCs/CCs/PEs
- Augment the existing role of the Reliability Panel with obligations to develop and maintain PE Guidelines



PE Guidelines



EFCS Guidelines



Revised FOS



Revised NER

STEP 2

Reliability Panel

Develops PE guidelines for PEs

- Guidelines provide guidance on classification
- Criteria for cost/benefit assessment for ex-ante levers
- Living document rather than NER text, able to be periodically reviewed on regular basis. Based on NER principles.

Develops EFCS guidelines for General Purpose schemes

- Guidelines provide guidance on how NSPs consider NCCs in planning and development of general purpose EFCS such as UFLS and OFGS.
- Criteria for cost/benefit assessment for NCCs, may refer to specific design events
- Living document rather than NER text, able to be reviewed as needed on regular basis. Based on NER principles.

Revises FOS

- Part B: (f) multiple *contingency event* changed to *protected event*
- Part A change *multiple contingency event* to *protected event* in Mainland Frequency Operating Standards table

APPENDIX B: EFCS/PE Framework Flowchart

