

Reliability Panel AEMC

ISSUES PAPER

Review of the System Restart Standard

19 November 2015

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About the Reliability Panel

The Reliability Panel (Panel) is a specialist body established by the AEMC and comprises industry and consumer representatives. It is responsible for monitoring, reviewing and reporting on reliability, security and safety of the national electricity system and advising the AEMC in respect of such matters. The Panel's responsibilities are specified in section 38 of the National Electricity Law.

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Contents

1	Introduction	1
1.1	Purpose.....	1
1.2	Review of the System Restart Standard	1
1.3	Terms of reference.....	2
1.4	Timetable for the Review	3
1.5	Submissions	3
1.6	Structure of the paper.....	4
2	Background	5
2.1	Major supply disruption and SRAS.....	5
2.2	Governance arrangements.....	7
2.3	Past reviews of System Restart Standard and related processes.....	11
3	Assessment Criteria.....	13
3.1	SRAS Objective.....	13
3.2	Role of the Panel.....	14
3.3	Factors relevant to the Panel's assessment of the Standard	15
4	Key issues and considerations in this review.....	18
4.1	Cost	18
4.2	Reliance on support from neighbouring sub-networks.....	20
4.3	Contingency	21
5	Developing the System Restart Standard	23
5.1	Structure of the Standard	23
5.2	Time and level of restoration.....	24
5.3	Aggregate reliability	26
5.4	Regional variation.....	27
5.5	Service to be acquired in one sub-network.....	29
5.6	Determining sub-networks.....	29
5.7	Diversity and strategic locations.....	30

Abbreviations.....	32
A Terms of Reference.....	33
B Current Standard.....	36

1 Introduction

1.1 Purpose

Under the National Electricity Rules (NER), the Reliability Panel (Panel) is responsible for determining the System Restart Standard (Standard) that applies to the NEM.¹ The Reliability Panel has been directed by the Australian Energy Market Commission to undertake a review of the Standard.

The purpose of this paper is to explain the role and function of the Standard and to seek stakeholder comment on the content of the Standard and the Panel's proposed approach for assessing it.

1.2 Review of the System Restart Standard

The Standard sets out several key parameters for power system restoration by the National Electricity Market (NEM) system operator, including the speed of restoration and how much supply is to be restored.² It is a standard against which the Australian Energy Market Operator (AEMO) procures System Restart Ancillary Services (SRAS) from contracted SRAS providers, such as generators with SRAS capability.³ In the event of a major supply disruption, SRAS may be called on by AEMO to supply sufficient energy to restart power stations in order to begin the process of restoring the power system. AEMO's development of the System Restart Plan must be consistent with the Standard.⁴ The purpose of SRAS is to restore supply following an event that has a widespread impact on a large area – such as an entire jurisdiction.⁵

The Standard does not set out the process of restoring supply to consumers directly following blackouts within a distribution network or on localised areas of the transmission networks. In addition there is a separate process, developed with input of jurisdictional governments to manage any disruption that involves the operator on a network having to undertake controlled shedding of customers. Restoration from these localised or controlled events is not covered by the Standard, and is therefore not considered in this review.

The current Standard, which the Panel determined in 2012 for application from 1 August 2013, can be seen in Appendix B. At the time, the Panel considered that the interim Standard, which had been in place since 2006, was working well and made only minor clarifications.⁶

1 Clause 8.8.3(a)(5) of the Rules.

2 Clause 8.8.3(aa) of the Rules.

3 Clause 3.11.7(a1) of the Rules.

4 Clause 4.8.12(c) of the Rules.

5 Supply is defined as “the delivery of electricity” in the Rules.

6 Reliability Panel, Final Determination - System Restart Standard, 2012.

Box 1.1 Consequences of a major supply disruption

Major losses of power supply have the potential to result in direct economic costs in terms of lost production of goods and services, as well as additional costs such as those resulting from disruption caused to transportation and communication networks. Public health risks can result, and these may be exacerbated by difficulties faced by emergency services in responding to events.

An example of a major supply disruption is the event that occurred in the Northern Territory (NT) on 12 March 2014. Power was lost in major population centres, including Darwin and Katherine. The NT power system operator, Power and Water Corporation, required 14 hours to restore supply to 80 per cent of the Darwin region. The event resulted in a day long closure of schools and businesses, with emergency services attending house fires caused by people cooking on camping stoves.⁷

1.3 Terms of reference

On 30 June 2015, the Australian Energy Market Commission (AEMC) provided Terms of Reference to the Panel to initiate a review of the Standard (the Review).

Among other things, the Terms of Reference require the Panel to undertake a review of the Standard to meet the requirements established in clause 8.8.3(aa) of the Rules, which were revised in July 2015 following a final rule determination made by the AEMC.⁸ The Standard provides the restoration timeframes and reliability requirements that AEMO must aim to meet when procuring SRAS. The Standard also sets out other matters that AEMO must consider, including SRAS diversity considerations⁹ and guidance on the boundaries of electrical sub-networks.¹⁰

The Panel is required to complete its Review of the Standard by December 2016. This timing provides scope for AEMO to subsequently develop any necessary revisions to the SRAS Guidelines and System Restart Plan so that those instruments are consistent with any amendments to the Standard that may result from this Review, before AEMO commences the process for SRAS procurement for the period commencing July 2018.¹¹

Any amendments to the SRAS Guidelines would need to be made in accordance with the Rules Consultation Procedures.

⁷ NT News, *Review slated for Darwin blackout*, 12 March 2014.

⁸ AEMC, *Final Determination - National Electricity Amendment (System Restart Ancillary Services) Rule*, 2015.

⁹ SRAS diversity considerations include electrical, technological, geographical and fuel matters.

¹⁰ A sub-network is part of a network defined by AEMO, reflecting factors including the concentration of load and generation, as well as the structure of the network. Currently, there is one sub network in each NEM region, with the exception of Queensland in which there are two.

¹¹ As explained in section 2.2.1, AEMO is responsible for the development of the SRAS Guidelines and System Restart Plan which must be consistent with the Standard.

The Terms of Reference for this Review can be seen in Appendix A.

1.4 Timetable for the Review

In carrying out this Review, the Panel will follow a consultation process that is consistent with clause 8.8.3 of the NER and the Terms of Reference. The Panel will consult with stakeholders through seeking submissions on this Issues Paper and a subsequent Draft Report. The Panel will also carry out a number of face to face meetings with stakeholders, workshops and forums. The first workshop with interested stakeholders will be held in the first quarter of 2016.

Table 1.1 sets out an indicative timetable that the Panel intends to follow in undertaking its review.

Table 1.1 Timetable for the review

Milestone	Proposed date
Publication of Issues Paper	19 November 2015
Close of submissions to Issues Paper	18 December 2015
First Workshop - Issues raised	1st Quarter 2016
Draft Report and Draft Standard	July 2016
Final Report and Standard	September 2016

1.5 Submissions

The Panel invites written submissions on this Review and Issues Paper from interested parties by no later than 18 December 2015. All submissions received will be published on the AEMC's website (www.aemc.gov.au), subject to any claims for confidentiality.

Electronic submissions must be lodged online through the AEMC's website using the link entitled "lodge a submission" and reference code "REL0057". The submission must be on letterhead (if submitted on behalf of an organisation), signed and dated.

Upon receipt of electronic submissions, the AEMC's website will issue a confirmation email. If this confirmation email is not received within three businesses days, it is the submitter's responsibility to ensure the submission has been delivered successfully.

If choosing to make submissions by mail, the submission must be on letterhead (if submitted on behalf of an organisation), signed and dated. The submission may be posted to

Reliability Panel
PO Box A2449
Sydney South NSW 1235

Or by Fax to (02) 8296 7899.

1.6 Structure of the paper

The remainder of this Issues Paper is structured as follows:

- Chapter 2 describes the background of how system restart operates in the NEM, and how the Standard fits into the overall governance arrangements for the restoration of the power system;
- Chapter 3 sets out the assessment criteria the Panel proposes to use in examining the Standard;
- Chapter 4 examines the key issues to be considered when determining the Standard; and
- Chapter 5 presents the initial considerations of the Panel on specific requirements of the Standard and invites stakeholder feedback on the questions enclosed.

2 Background

The chapter sets out the background for the Review. This chapter examines

- what a major supply disruption would entail, and what is needed to recover the system (section 2.1);
- the governance and institutional arrangements for the system restart process generally, as well as the procurement of system restart ancillary services (section 2.2); and
- historical reviews and findings of system restart capacity (section 2.3).

2.1 Major supply disruption and SRAS

2.1.1 What is a major supply disruption?

SRAS is procured by AEMO in order to mitigate the impact of a major supply disruption. The NER defines a major supply disruption as "the unplanned absence of voltage on a part of the transmission system affecting one or more power stations and which leads to a loss of supply to one or more loads."¹²

There has never been an event in the NEM that has required SRAS to be called on by AEMO. Even so, the availability of SRAS in response to such a possible event is important as there are likely to be significant economic and social costs associated with the total loss of power supply to a region(s) for an extended period of time, although the magnitude of these costs may vary between consumers. In many ways, SRAS can be likened to an "insurance policy" where AEMO procures SRAS to more quickly restore the power system so that the potential costs of major supply disruptions can be reduced.

Sustained major power outages are rare by international standards, but serious consequences and threats to life and the economy can result when they do occur. For example, one of the most prominent major supply disruptions occurred in North America in 2003, where 50 million people lost power for up to two days. This was estimated to have cost around \$6 billion at that time and contributed to 11 deaths.¹³

In addition to being rare, major supply disruptions are potentially initiated by diverse events, making them impossible to predict. While mitigation processes and procedures generally exist to guard against such occurrences, major supply disruptions still have the potential to occur due to an unforeseen series of improbable events, such as mechanical or human failures.

¹² Not all major supply disruptions lead to a system black condition and, therefore, would require SRAS to restore supply to affected customers.

¹³ Productivity Commission 2013, *Electricity Network Regulatory Frameworks*, Report No. 62, Canberra, p.13.

2.1.2 Why is SRAS necessary?

Under standard operating conditions in the NEM, generating units require some machinery to initiate and operate, such as conveyer belts, compressors, pumps and coal pulverisers, which are known as auxiliaries. These auxiliaries need a power supply to operate. Generating units that are offline (ie, not exporting any energy into the system), but functional can use power from the grid to facilitate the starting up of auxiliaries and eventually start exporting energy. In the eventuality that the power supply from the grid became unavailable, due to a major supply disruption, many generating plants would be incapable of starting their auxiliaries and then commencing operation.

SRAS are services provided by generating facilities with black start capability which allows energy to be supplied and a connection to be established, sufficient to restart large generating units following a major supply disruption. That is, SRAS is provided by generators which have the capability to start, or remain in service, without electricity being provided from the grid.¹⁴ Generating units providing SRAS commence generation and export energy to the grid and this energy is then used by other generating units to commence and start exporting as well.

A number of different technologies may be used to provide SRAS, including:¹⁵

- generating units that can restart without being connected to the grid, such as hydro or various gas turbine generating units;
- 'trip to house load' schemes, which include large generating units that can disconnect from the grid in the event of a major supply disruption and continue to supply their own auxiliaries; and
- combination system restart sources, which are large generating units that can be started from a nearby small power station, such as a thermal power station with a gas turbine generating unit that is capable of starting without grid supply.

SRAS is procured on the basis of the restoration of power to a specific sub-network. A sub-network is a part of the network defined by AEMO, reflecting factors including the concentration of load and generation as well as the structure of the network. AEMO determines the borders of the sub-networks with reference to guidelines included in the Standard. Further discussion of the Panel's approach to these guidelines is provided in section 5.6.

¹⁴ This is defined under the Rules as a capability that allows a generating unit, following its disconnection from the power system, to be able to deliver electricity to either:
(a) its connection point; or
(b) a suitable point in the network from which supply can be made available to other generating units,
without taking supply from any part of the power system following disconnection.

¹⁵ Australian Energy Market Operator, *System Restart Ancillary Services - Final Report*, AEMO, 12 February 2014, p.7.

2.1.3 The process for responding to a major supply disruption

In the event of a major supply disruption occurring, AEMO is likely to use different methods to restore the power system. This may include calling upon SRAS and, if available, requesting the provision of energy from unaffected regions.

Under black system conditions following a major supply disruption, electricity from a SRAS facility is primarily used to restart other significant generating units, typically large coal or gas fired units. The initial priority in the event of a major supply disruption will likely be the restoration of power generation. Supply to consumers will be restored in a manner which is consistent with the safe restoration of power generation. The order in which consumers' power is restored after a major supply disruption is determined by a number of different factors. The Rules set out requirements relating to the restoration of sensitive loads which AEMO must meet.¹⁶

Black system conditions would represent a large departure from the normal operation of the network, potentially including some degree of unforeseeable damage to, or unavailability of, transmission and generation assets. As a consequence, it is impossible to plan for all possible eventualities in the System Restart Plan and supporting black start procedures for each NEM region.¹⁷

2.2 Governance arrangements

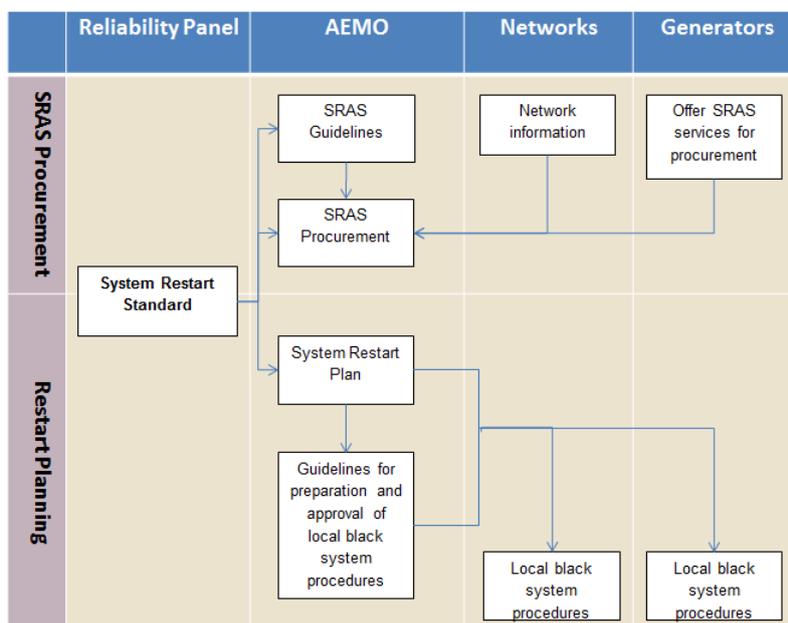
2.2.1 Preparing for a major supply disruption

Making preparations for restoring the system after a major supply disruption is an important component of the governance to maintain security in the network. The NER sets out high level requirements for a number of organisations to prepare the system to be able to be restarted if necessary. Specific parties that have key roles in determining system restart service provision include the Panel, AEMO, networks, and generators. A graphical representation of these responsibilities is laid out in Figure 2.1.

¹⁶ For example clause 5.9.6(b) of the Rules.

¹⁷ Under the NER, AEMO is required to procure SRAS for the eventuality that each sub-network is unable to provide assistance to its neighbours. During an actual system restart, however, AEMO will call upon whatever resources are available to restore the power system as quickly as possible.

Figure 2.1 Responsibilities of parties in preparing for a major supply disruption



Reliability Panel

Under clause 8.8.3(aa) of the Rules, the Standard must be reviewed and determined by the Panel in accordance with the SRAS Objective.¹⁸ The Standard must contain several parameters for the restoration of the power system following a major supply disruption, including the maximum amount of time in which a specified level of supply must be restored in each sub-network, and the aggregate level of reliability of restart services in each sub-network.

As shown in Figure 2.1, the Standard is used to set the high level requirements for AEMO's process in determining procurement of SRAS, and help inform the System Restart Plan. In undertaking the examination of the Standard, the Panel will take into account the impacts on consumers of the provision of SRAS in accordance with the Standard. However, the primary focus of the Standard is on the restoration of generation to allow consumers subsequently to be brought on line.

For example, the current Standard requires that AEMO procure sufficient SRAS to "restore generation and transmission such that 40 per cent of peak demand in [each] sub-network could be supplied within four hours of a major supply disruption occurring." This is not a requirement that AEMO procure SRAS so 40 per cent of peak demand or load is restored within four hours. Rather, it is a requirement that AEMO procure SRAS so that generation capacity equivalent to 40 per cent of peak demand is capable of being dispatched at the fourth hour after a major supply disruption.

As laid out below, in accordance with their local black system procedures and instructions from AEMO it is the responsibility of network operators to restore power

¹⁸ The SRAS Objective is defined in the Rules, as outlined in section 3.1 of this Issues Paper.

to individual consumers. Restoration of supply to consumers may not occur until a number of hours after the restoration of capability for generators as contemplated in the Standard.

AEMO

AEMO's responsibilities are established in the Rules, subject to the relevant guidance included in the Standard.

Under the Rules AEMO is required to develop the SRAS Guidelines.¹⁹ These SRAS guidelines must include:

- a description of the technical and availability requirements of SRAS;
- a process for meeting the SRAS aggregate required reliability requirement of the Standard for each electrical sub-network;
- a process for the modelling, assessment and physical testing of SRAS by an SRAS Provider, including any assumptions to be made by AEMO regarding the state of transmission elements during a major supply disruption;
- a process for determining the number and location of SRAS required to be procured for each electrical sub-network consistent with the Standard;
- guidance to Registered Participants on the factors that AEMO must take into account when making a decision to follow a particular type of procurement process to acquire SRAS;
- a process for AEMO to follow for contacting a potential SRAS Provider to negotiate the provision of SRAS without a competitive tender process; and
- a process for a potential SRAS provider to contact AEMO to offer the provision of system restart ancillary services without a competitive tender process, which offer AEMO is in no way obliged to accept.

AEMO is responsible for procuring SRAS to meet the Standard at the lowest cost.²⁰ AEMO assesses the ability of procured SRAS to meet the parameters of the Standard through detailed testing and power system modelling.

AEMO is required to report annually on the total annual cost of SRAS in each sub-network and region, and whether SRAS was not procured to a level satisfactory to meet the Standard in any sub-network.²¹

¹⁹ Clause 3.11.7(c) of the Rules

²⁰ Clause 3.11.7(a1) of the Rules

²¹ Clause 3.11.10 of the Rules

AEMO facilitates the recovery of the cost of SRAS from those regions that benefit from the SRAS service.²² These costs are split equally between Generators and Market Customers.

AEMO must also develop a confidential System Restart Plan for the purpose of managing and coordinating system restoration activities during any major supply disruption. The plan must be consistent with the Standard.²³ In addition, AEMO is required to prepare guidelines for usage by networks and generators to develop their black start procedures.²⁴ The networks and generators must submit the black start procedures to AEMO for approval (see below).

Networks

The networks are responsible for providing AEMO with information to facilitate the procurement of SRAS.²⁵ They must provide information that AEMO reasonably requires to assess the capability of a SRAS to meet the system restart standard.

The networks are also required to prepare and submit to AEMO local black start procedures that would be utilised during a black system event. Amongst other matters, local black system procedures must provide information to enable AEMO to understand the likely condition and capabilities of plant following any major supply disruption so that AEMO can co-ordinate the safe implementation of the system restart plan. This may be amended, if there is a change of circumstances or a request from AEMO.²⁶

The Panel notes that there is no obligation for network operators to be directly involved in the procurement of SRAS, outside of the provision of requested information by AEMO. Currently, Transmission Service Providers (TNSPs) do not have an obligation under the Rules to confirm that the supplied SRAS would be able to restore the power system in accordance with the requirements of the Standard.

Generators

Generators with the relevant specialised equipment are able to offer to provide SRAS. Generators that receive payment for the provision of SRAS are required to maintain their restart capacity and undertake regular testing as set out in the guidelines.

Generators must prepare and submit to AEMO local black system procedures on the actions that would be taken in the eventuality of a major supply disruption.²⁷

22 Clause 3.15.6A(c2) of the Rules

23 Clause 4.8.12(c) of the Rules

24 Clause 4.8.12(e) of the Rules

25 Clause 3.11.9(i) of the Rules

26 Clause 4.8.12(d) of the Rules.

27 Clause 4.8.12(d) of the Rules.

2.2.2 Activities during a major supply disruption

In the eventuality of a major supply disruption, AEMO is responsible for informing all affected registered participants.²⁸ AEMO would then follow the System Restart Plan to restore the system. If necessary, AEMO can adapt or vary the System Restart Plan to meet specific power system conditions.²⁹

Generators and networks are required to undertake the actions set out in their black start procedures if a major supply disruption occurs.³⁰ In addition, generators, networks and market customers must follow all directions from AEMO in restoring the system.³¹

2.3 Past reviews of System Restart Standard and related processes

2.3.1 System restart ancillary service arrangements and pricing under market suspension rule change

In 2006 the AEMC made a rule concerning the standards for, procurement of and use of SRAS.³² As required by this rule, AEMO (then NEMMCO) created an Interim Standard in 2006 following public consultation, and the approval of the Panel.³³

2.3.2 Review of the System Restart Standard

The Panel was required under the Rules to undertake a review of the Interim Standard, which was undertaken in 2012. The Panel made only minor changes to the Standard at this time.³⁴

2.3.3 Review of SRAS Guidelines

AEMO commenced a review of the SRAS guidelines in 2013. This review was completed in 2014. As a consequence of this review AEMO reduced the number of sub-networks, undertook revisions to its modelling techniques and removed references to the minimum number of services that were to be procured within each sub-network.³⁵

28 Clause 4.8.14(a) of the Rules.

29 Clause 4.8.14(c) of the Rules.

30 Clause 4.8.14(b) of the Rules.

31 Clause 4.8.14(d)-(e) of the Rules.

32 AEMC, National Electricity Amendment (System restart ancillary service arrangements and pricing under market suspension) Rule, 2006.

33 AEMO, *Interim System Restart Standard*, 2006.

34 Reliability Panel, *System Restart Standard, Final Determination*, 2012 .

35 AEMO, *SRAS documents consultation*, 2014.

2.3.4 System Restart Ancillaries Services rule change

AEMO and a group of generators submitted separate rule change requests to amend the NER in relation to SRAS in 2013.³⁶

The AEMC consolidated these rule change requests in 2014 and made a final determination and final rule in April 2015.³⁷ This rule amended the SRAS framework by:

- clarifying the roles and responsibilities of AEMO and the Panel - that the Panel develops the Standard and AEMO procures SRAS to meet the Standard at the lowest cost;
- clarifying that the Panel must include in the Standard the timeframes for the standalone restoration of each sub-network under conditions that would be expected under a NEM-wide black system event
- changing the definitions of SRAS, to remove the definitions of primary and secondary services; and
- recovering SRAS costs on the basis of the regional benefits they provide.

2.3.5 SRAS procurement for 2015-18

On 30 June 2015, AEMO completed its procurement of SRAS for the period 2015-2018. This procurement was undertaken under the procedure laid down in the 2014 guidelines (not under the new Rule). This resulted in a reduction in the number of SRAS sources procured and consequently the total cost for the provision of the service. The outcomes of this procurement are discussed in more detail in section 4.1.

³⁶ Specifically, AGL, Alinta Energy, Energy Brix, GDF Suez, Intergen, the NGF and Origin Energy

³⁷ AEMC, National Electricity Amendment (System Restart Ancillary Services) Rule 2015.

3 Assessment Criteria

This chapter sets out the proposed assessment method the Panel will follow in reviewing the current Standard and in particular:

- the SRAS Objective that the Standard must be reviewed and determined by; (section 3.1);
- the role of the Panel in setting the Standard (section 3.2); and
- the information the Panel considers relevant in its assessment of the Standard (section 3.3).

3.1 SRAS Objective

The Panel must review and determine the Standard in accordance with the SRAS Objective, as set out below.³⁸

“The objective for system restart ancillary services is to minimise the expected costs of a major supply disruption, to the extent appropriate having regard to the national electricity objective.”

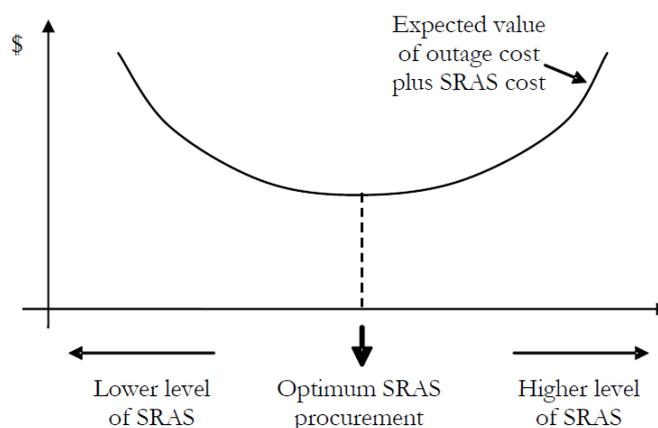
The SRAS Objective requires a Standard that minimises the total cost of a major supply disruption. This total cost would be equal to the ongoing cost of providing restart services plus the cumulative costs to society of a prolonged outage following a major supply disruption. However in setting the Standard in this way the Panel needs to consider the extent to which this is appropriate, having regard to the National Electricity Objective. This will involve consideration of various economic factors, including the trade-offs that exist between the ongoing cost of procuring SRAS against the short term costs of supply loss and the longer term costs of economic disruption.³⁹

The SRAS Objective implies that the Panel should determine a Standard that requires AEMO to procure an optimal volume of SRAS. The optimal level is where the marginal benefit of procuring an additional service is approximately equal to the marginal cost of procuring that service. Graphically, this means that the goal of the Panel is to develop a Standard that leads to a procurement level of SRAS that is situated at the bottom of the cost curve shown in Figure 3.1.

³⁸ See Clause 8.8.3(aa)(1) of the NER.

³⁹ AEMC Rule Determination – System Restart Ancillary Services, April 2015, p.iii.

Figure 3.1 Optimum level of SRAS Procurement⁴⁰



The Panel considers that there are a range of approaches that it could utilise to determine a Standard that meets the SRAS Objective. While an analysis of the marginal cost and marginal benefit of each additional unit of SRAS may be considered, the Panel also intends to use other approaches to inform its determination of the Standard. These other approaches, which are described in further detail in section 3.3, will complement any quantitative analysis of the costs and benefits of SRAS procurement.

3.2 Role of the Panel

As described in section 2.2, the Panel's determination of the Standard is one element of the wider SRAS procurement process that follows and, further, is one element in a much broader process to restore electricity supply to consumers following a major supply disruption.

The Standard is used by AEMO in preparing guidelines for SRAS procurement. In addition, AEMO must follow the Standard when procuring SRAS and preparing the System Restart Plan.

The Standard must:⁴¹

- identify the maximum amount of time within which system restart ancillary services are required to restore supply in an electrical sub-network to a specified level, under the assumption that supply (other than that provided under a system restart ancillary services agreement acquired by AEMO for that electrical sub-network) is not available from any neighbouring electrical sub-network;⁴²
- include the aggregate required reliability of system restart ancillary services for each electrical sub-network;

⁴⁰ Firecone, Review for AEMC of the Proposed NEMMCO Rule for System Restart Ancillary Services, 2005, p. 6.

⁴¹ Clause 8.8.3(aa) of the NER.

⁴² Prior to the 2015 SRAS Rule the Panel was not required to assume supply would not be available from neighbouring sub-networks.

- apply equally across all regions, unless the Panel varies the system restart standard between electrical sub-networks to the extent necessary:
 - to reflect any technical system limitations or requirements; or
 - to reflect any specific economic circumstances in an electrical sub-network, including but not limited to the existence of one or more sensitive loads;
- specify that a system restart ancillary service can only be acquired by AEMO under a system restart ancillary services agreement for one electrical sub-network at any one time;
- include guidelines to be followed by AEMO in determining electrical sub-networks, including the determination of the appropriate number of electrical sub-networks and the characteristics required within an electrical sub-network (such as the amount of generation or load, or electrical distance between generation centres, within an electrical sub-network); and
- include guidelines specifying the diversity and strategic locations required of system restart ancillary services.

In addition, the Terms of Reference for this Review require the Panel to have regard to a range of other considerations including:

- the value of system restoration to consumers following a major supply disruption, such as AEMO's Value of Customer Reliability (VCR); and
- the estimated costs of sourcing restart services.

3.3 Factors relevant to the Panel's assessment of the Standard

In determining the Standard, the Panel intends to consider:

- the physical underpinnings of the power system, including minimum load levels needed to restore stability on the main transmission flow paths as well as the physical limitations of the system that may be relevant to the minimum technically feasible timeframe for system restoration;
- the results of consultation with jurisdictional governments to identify any specific issues or matters, in the context of different speeds of restoration and the cost of restart services to deliver that speed of restoration in specific jurisdictions;
- feedback received from stakeholders through written submissions, workshop participation or discussions; and
- the potential SRAS price signals necessary to drive efficient long term investment in restart services.

As part of the review the Panel will explain how the Standard is connected with the overall process for restoration after a major supply disruption. It will be critical for the Panel to understand how restoration of supply to consumers is carried out, including the timings and expectations in that context. This will have implications for the Standard which is concerned with the restoration of the power system of a whole.

3.3.1 Detailed analysis

The Panel intends to undertake additional analysis of the issues that would inform its determination of the Standard and assist stakeholders. This includes:

- a summary of international developments relating to restoration following major supply disruptions;
- technical analysis of the ability to meet any amendments to the Standard; and
- economic analysis of costs of any potential black system event.

Comparison with other jurisdictions

The Panel will examine examples of major supply disruptions that have occurred historically and in other jurisdictions. The Panel intends to investigate the causes of these events and the responses by the system operators and other parties. In addition, the Panel will examine the governance arrangements that are used in other jurisdictions for the restoration of supply after major supply disruptions.

Where possible, the Panel will also undertake a comparison of the Standard with the requirements of equivalent documents in other jurisdictions including the settings for restoration timeframes, levels of load to be restored, diversity requirements, definitions of sub-networks and the required reliability of restoration. This analysis will inform the Panel's consideration on the appropriateness of making any amendments to the existing Standard.

Technical capability

The settings of the Standard should reflect the physical capabilities of the power system. The Panel will seek technical advice from AEMO relating to the nature of these physical capabilities in the NEM. For example, the Panel may seek advice from AEMO on the fastest timeframe for system restoration that could be met, given the physical limitations of the power system and other matters relating to technical feasibility of the power system. Recognising the role that generators and networks operators play in system restoration, the Panel also welcomes any input from network operators and generators regarding technical capability.

Economic Analysis

The Panel will undertake analysis of the potential economic costs of major supply disruptions of varying duration. This analysis would take into account any relevant

value of customer reliability of impacted consumers, but may also examine other impacts of a widespread supply outage.

An example of a potential impact includes economic loss due to product spoilage and a loss of ability to carry out business activities. Such an analysis may help to inform the Panel of the likely value of the provision of SRAS.

The Panel is currently scoping this work and welcomes stakeholder submissions on the key considerations that are relevant to this element of its analysis. This analysis will be one of a range of considerations in the determination of any potential amendments to the Standard.

4 Key issues and considerations in this review

This chapter outlines some of the key issues and considerations that stakeholders have raised in previous examinations into the governance and procurement of SRAS and which could be relevant to the Panel's considerations in this review.

These issues relate to:

- the cost of SRAS procurement and major supply disruptions, as described in section 4.1;
- conditions for which restoration needs to be planned for, as described in section 4.2; and
- the level of contingency of the availability of SRAS services, as described in section 4.3.

4.1 Cost

The procurement of SRAS represents a direct and quantifiable financial cost to consumers and generators. On the other hand, in the event of a major supply disruption, society would face large and unspecified costs. As outlined in chapter 3, the responsibility of the Panel in setting the Standard is to minimise the sum of these ongoing costs to the extent appropriate.

4.1.1 Cost of provision of SRAS

The costs of providing SRAS to a region are met by the generators and market customers in that region. Between 2006 and 2014, the cost of SRAS procurement by AEMO increased from \$15 million in 2007-08 to \$55 million a year in 2013-14. As a consequence, concerns were raised over the cost of provision of the service.⁴³

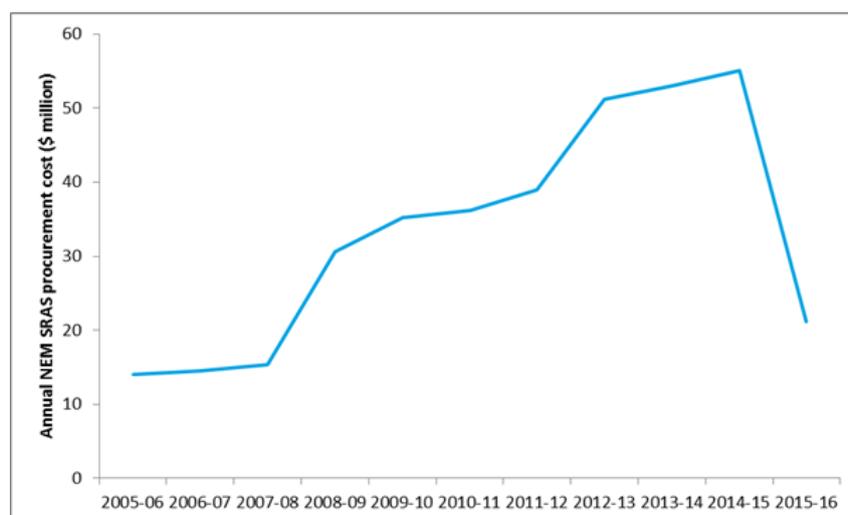
In June 2015, AEMO announced the outcome of its procurement of SRAS for the period 2015-2018. As a result of this tender, the total amount AEMO expects to spend on the acquisition of SRAS dropped from \$55 million a year in 2014-15 to \$21 million a year in 2015-16, representing a reduction of 62 per cent, which is still higher than the cost of SRAS in the period before 2007-08.⁴⁴

Figure 4.1 shows the change of NEM SRAS expenditure in nominal terms over the last ten years.

⁴³ \$55 million a year is equivalent to approximately \$0.30/MWh, assuming a NEM wide annual energy demand of 180,300 GWh.

⁴⁴ AEMO, *System Restart Ancillary Services 2015, Tender Process Report*, 2015.

Figure 4.1 Annual nominal procurement cost for SRAS in the NEM



The reduction in cost in the last year was largely driven by a reduction in the number of sources procured by AEMO. Across the NEM, AEMO procured 20 SRAS sources as part of the 2012-2015 procurement. In the period 2015-2018, this has been reduced to only 10 sources.

The Panel understands from AEMO that the reduction in the number of SRAS procured was largely due to three changes, specifically:

- the reduction in the number of sub-networks;
- the removal from AEMO's guidelines of the requirement to have a minimum of two SRAS sources in each sub-region; and
- the usage of more detailed modelling techniques.

4.1.2 Cost of major supply disruption

A major supply disruption could lead to large social costs. The exact full extent of the cost of such an event, along with the probability of it occurring, is impossible to determine. However, as described in section 3.3 the Panel is investigating estimates of the costs as part of this review.

The Panel notes the existence of sensitive loads in some regions. The loss of supply to these loads for an extended period of time may therefore have significant costs. For example, Tomago, an aluminium smelter, noted that a loss of electricity supply for a matter of hours "can have a catastrophic effect on the plant such that all production would cease and the aluminium in the pots would freeze".⁴⁵ Obtaining a clear understanding of the power system's ability to restore supply to sensitive loads within

a critical time period is a key concern of the Panel in this Review. The Panel also notes the requirements associated with 'sensitive loads' as defined in the NER and the obligations on AEMO and the Jurisdictional System Security Coordinator, regarding these 'sensitive loads'.

4.2 Reliance on support from neighbouring sub-networks

Due to the unpredictability and rarity of large-scale events, it is not possible to determine when a major supply disruption will occur, nor what the magnitude of the event will be. One specific issue is how widespread a major supply disruption could be. If a supply disruption occurred in one region, then neighbouring energised regions could help in the restoration of de-energised areas. However, if a major supply disruption occurred in all regions, then each region would need to be able to independently be restored.

DNV KEMA and ROAM Consulting undertook analysis on the possible spread of a major supply disruption, which helped inform the AEMC's decision in relation to the 2015 SRAS Rule.

4.2.1 DNV KEMA report

As part of the review of the SRAS guidelines that AEMO began in 2013, AEMO commissioned DNV KEMA to undertake a review of AEMO's responsibilities to procure SRAS. One area that DNV KEMA was to report on was the relative probability of a NEM-wide, compared to a region-wide, major supply disruption.⁴⁶

DNV KEMA examined the network for natural breakpoints where the power system might separate and the impact of these in the eventuality of a major supply disruption. From the results of its assessment, DNV KEMA concluded that they "do not believe there is any credible event that could cause a NEM-wide blackout".⁴⁷ Instead, DNV KEMA considered that it was likely that the transmission network would separate at one of the identified break points during a major supply disruption. As a consequence, DNV KEMA recommended that AEMO undertake its assessment based on the assumption of regional events.

4.2.2 ROAM consulting report

In 2014, ROAM Consulting was engaged by the NGF and Private Generators Group to examine the probability of major supply disruptions, and the potential for a NEM-wide event. ROAM Consulting undertook a statistical analysis, based on the frequency of events in systems of different sizes. ROAM concluded that the possibility of an event in two neighbouring regions, such as NSW and Victoria had a potential to occur. During

⁴⁵ Tomago, Submission to System Restart Ancillary Services rule change consultation paper, p. 1, 2014.

⁴⁶ DNV KEMA, *AEMO responsibilities to procure SRAS*, 2013, p. 20.

⁴⁷ *Ibid*, p. 10.

such an event, the two regions would be unable to help restore one another.⁴⁸ As a consequence the NGF considered that the procurement used by AEMO would need to allow for a NEM-wide or multi-region event.⁴⁹

4.2.3 AEMC conclusion in the 2015 determination

The issue was considered by the AEMC as part of the assessment of the National Electricity Amendment (SRAS) rule change request in 2015. In examining this issue, the AEMC considered that it was not possible to determine whether or not a NEM wide event could occur. Therefore, the AEMC considered that procurement must take place on the assumption that a sub-network is not capable of being re-energised from a neighbouring sub-network. This means that AEMO is required to procure the necessary quantities of SRAS to enable each sub-network to be restored within the timeframes of the Standard, under the assumption that energy (other than energy provided by contracted restart services) was not available from a neighbouring, energised sub-network to assist in restoration.⁵⁰ This assumption is a Rules requirement and not the subject of this review.

AEMO has undertaken its procurement of SRAS, most recently in 2015, on the basis of restoring each sub-network individually.

4.3 Contingency

In previous procurement rounds for SRAS, AEMO undertook its procurement with a minimum of two sources in each sub-network. As part of the review of the SRAS guidelines by AEMO which began in 2013, AEMO removed the minimum requirement of the number of sources.

In its final report and determination, AEMO noted: "Instead, the number of SRAS procured [is] based on AEMO's determination of the quantity and combination of services that will most efficiently meet the [Standard] for each electrical sub-network."⁵¹

Under the current Standard, as described in section 5.3, AEMO would take into account the reliability of each individual SRAS source in making its procurement. However, the Standard represents a procurement Standard and not an operational one. The Standard is not a specification of any operational requirement should be achieved in the event of a black system condition – and the reason for that is that it would be impossible to meet an operational Standard.

⁴⁸ ROAM Consulting, *Review of System Restart Ancillary Services (SRAS) Requirements in the NEM*, 2014.

⁴⁹ NGF, *Submission to Consultation Paper - System Restart Ancillary Services requirement rule change*, 2014.

⁵⁰ AEMC, *Final Determination - National Electricity Amendment (System Restart Ancillary Services) Rule 2015*, p. iii.

⁵¹ AEMO, *SRAS Documents Consultation: Final Report and Determination*, 2014, p. 17

Some stakeholders consider that increasing the number of SRAS sources that are available for restart services in each sub-network, may improve the confidence that the restoration timeframes set in the Standard would be met. For example, TransGrid considers that increasing the number of SRAS sources allows AEMO to choose from a greater range of SRAS services and transmission pathways for system restoration and gives AEMO greater capability to deal with obstacles created by damaged generation or transmission assets.⁵²

In addition, some stakeholders may consider that increasing the number of sub-networks in NEM regions, and requiring that each sub network can be restored individually without assistance with their neighbours, would achieve the same result.⁵³

Any measures that lead to improvements in confidence of power system would need to be balanced against an increased cost of procuring additional services as examined in section 4.1. In addition, these would need to be considered alongside the physical limitations of the system.

⁵² TransGrid, Submission to AEMO SRAS Guidelines Stage 1 consultation, 2014.

⁵³ See Snowy Hydro, Submission to draft determination - System Restart Ancillary Services Rule, 2014, p. 2.

5 Developing the System Restart Standard

This chapter examines the issues the Panel will consider in developing any revisions of the Standard. The initial section examines the purpose and structure of the Standard. After this, each section sets out the Panel's initial considerations of a requirement of the Terms of Reference and asks questions for stakeholder feedback.

5.1 Structure of the Standard

5.1.1 Procurement Standard

The Standard is currently set out as a procurement target for AEMO. Therefore, in meeting the Standard, AEMO must procure sufficient SRAS to meet the requirements of the Standard. While AEMO would aim to restore the power system as to the requirements of the Standard following a major supply disruption, it is not accountable in an operational sense if the timeframe and level of restoration specified in the Standard is not met. However, AEMO would be accountable if the procurement meant the Standard could not be met.

In 2012 the Panel clarified that this requirement is a procurement standard and not an operational standard.⁵⁴ As part of the SRAS rule change, the Commission considered the issue and concluded that the form of the Standard be determined by the Panel.⁵⁵

5.1.2 Requirements of the Standard

As discussed in section 3.2, the requirements for the Panel to examine in the Standard are set out in clause 8.8.3(aa) of the NER. These requirements were amended as part of the 2015 SRAS Rule Change. The requirements in the NER relating to the Standard have been amended to:

- specify that procurement for each sub-network must take place under the assumption that supply (other than that provided under a SRAS agreement acquired by AEMO for that electrical sub-network) is not available from any neighbouring electrical sub-network;
- include a requirement for aggregate reliability of SRAS in each sub-network;
- remove the requirement for the Panel to specify guidelines for primary and secondary services; and
- require the Standard to specify that SRAS can only be acquired by AEMO for one electrical sub-network at any one time.

⁵⁴ Reliability Panel, *System Restart Standard: Final Determination*, 2012, p. 13.

⁵⁵ AEMC, *System Restart Standard Final Determination*, 2015, p. 46. The system restart standard is defined in the Rules as the standard as determined by the Reliability Panel for the acquisition of SRAS.

5.1.3 Interaction of elements of the Standard

AEMO is responsible for procuring enough SRAS sources to meet the Standard. As discussed in section 3.2, the Panel is responsible for setting the Standard so that the total ongoing cost of procurement and potential cost of a major supply disruption is minimised.

The Panel notes that the elements of the Standard, while discussed individually below, could potentially interact in a number of manners. For example, an increase to the number of services procured could potentially be achieved through:

- decreasing the maximum time of restoration;
- increasing the level of restoration required;
- specifying a higher level of reliability of SRAS; or
- changing the requirements relating to sub-networks, so that AEMO is required to consider more and smaller sub-networks.

In specifying the Standard, the Panel will need to have regard to how different elements were to interact, and the best ways of combining any changes so to best meet the SRAS Objective.

5.2 Time and level of restoration

The Panel is required to set the Standard that identifies the maximum amount of time within which SRAS is required to restore supply to a sub-network to a specific level.

Currently the Standard requires that "[f]or each electrical sub-network, AEMO shall procure SRAS sufficient to:

- re-supply and energise the auxiliaries of power stations within 1.5 hours of a major supply disruption occurring to provide sufficient capacity to meet 40 per cent of peak demand in that sub-network; and
- restore generation and transmission such that 40 per cent of peak demand in that sub-network could be supplied within four hours of a major supply disruption occurring."⁵⁶

5.2.1 Time for restoration

In determining the speed of restoration, the Panel may also compare the estimated cost of a black system event of different lengths, with the issues faced in requiring a faster restoration.

⁵⁶ Reliability Panel, System Restart Standard, 2012, p. 2.

The Panel will need to determine whether the timeframes, as determined in the current Standard are still appropriate. As a minimum, any revision to these requirements in the Standard would need to be made so as to be technically feasible. There would be a length of time that could not be met, regardless of how much SRAS was procured, based on the physical capabilities and limitations of the power system. In addition, any changes to the proposed restoration timeline would need to balance the expected value from a shorter black system event to a higher cost of providing additional SRAS.

5.2.2 Level of restoration

In determining the level of restoration in the Standard, the Panel will need to take into account the costs of meeting that level of restoration, balanced against the likely costs of major supply disruptions of differing lengths. The Panel will also need to consider if the existing definition of the level (ie, percentage of peak demand) is appropriate, or whether a different definition should be determined. The Panel may also consider whether the inclusion of intermediary steps, such as a requirement to power auxiliaries, is effective in driving efficient procurement of SRAS.

In developing the Interim Standard, AEMO was guided in an estimation of the capabilities of what levels and speed of restoration are technically feasible. AEMO considered that restarting the first generating unit would take approximately 1.5 hours. In addition, AEMO estimated that it would take an SRAS unit four hours to fully restore capacity at two generating units and bring an additional two units up to 25 per cent capacity.⁵⁷

The requirement to procure so that 40 per cent of peak demand "could be supplied" is a requirement for AEMO to procure sufficient SRAS so that there is generation capacity to 40 per cent of peak load available at the four hour mark. The Standard does not require a certain level of load to be energised, as load is restored when the networks and AEMO are able to do so.

The Panel also notes that since the creation of the Interim Standard, there have been changes to the relationship between average and peak demand. Notably, peak demand has risen at a faster rate than average demand. Consequently, maintaining a standard of restoration of 40 per cent of peak demand may result in a level of procured SRAS that exceeds the amount necessary to stabilise the power system under most conditions.

5.2.3 Structure of time and level requirement

The current Standard sets an intermediate target of 1.5 hours to restore station auxiliaries of power stations that can provide capacity to meet 40% of peak demand in the sub-network. There may be potential SRAS sources that may be available within four hours, but unable to restart auxiliaries in 1.5 hours. Under the current Standard,

⁵⁷ AEMO, Interim System Restart Standard, 2006, pp. 7 - 9.

these sources would be unable to be procured as SRAS. Potentially the requirement for an intermediate step may be acting as a barrier to potential SRAS providers.

On the other hand, it is possible that after the fourth hour after a major supply disruption, the power system may not have fully restored to normal conditions. This may be the case, even though enough supply is available at the fourth hour to supply 40 per cent of peak load in the sub-network. There may be some value for including subsequent requirements or expectations on the provision of SRAS in the critical hours after the initial period of a major supply disruption.

Question 1 Time and level of restoration

- 1. Are the existing timeframes for restoration appropriate (ie, 1.5 hours for restoration of station auxiliaries of generating units that can supply 40 per cent of peak demand in the sub-network and 4 hours for generation capacity equivalent to 40 per cent of peak demand)? If the timeframes are not appropriate, how should they be amended?**
- 2. Do stakeholders consider that the restoration level be maintained at 40 per cent of peak load? If not, what other restoration level should be considered, and why (eg, a different percentage rate, or average demand instead of peak demand)?**
- 3. Is the powering of auxiliaries as an intermediate step a necessary part of the definition of the Standard? What are the costs and benefits of removing the intermediate step and moving to a single timeframe for power system restoration (eg, restore 40 per cent of peak demand within 4 hours)?**

5.3 Aggregate reliability

The reliability of a system restart service is the probability that the service will be available when requested. Under the current Standard, this is expressed as the reliability of an individual service.

As part of the 2015 SRAS Rule, the Commission amended the requirement in the Rules for the setting of reliability in the Standard. In accordance with the revised Rules, and the Terms of Reference for this review of the Standard, the Panel must determine an aggregate reliability to be met in each sub-network. The aggregate reliability is the combined reliability of all the SRAS procured in a single sub-network.

Under the current Standard, a service is classed as a "primary service" if it has reliability of 90 per cent or more. If a system restart service has a reliability of above 60 per cent, it is classed as a "secondary service". However, the concepts of primary and secondary service have been removed from the Rules as part of the 2015 SRAS Rule. The Commission considered that this change "may expand the range of restart services

that AEMO can choose from when procuring SRAS to meet the System Restart Standard."⁵⁸

Under the current Standard, AEMO does not need to consider the reliability for service provision across a sub-network, although services can be considered jointly to meet reliability requirements.

In determining the appropriate level of reliability for the revised Standard, the Panel would need to consider that a higher level of reliability may lead to a higher number of services procured. Consequently, there will be a need to balance the cost of additional services against the expected benefit from increased aggregate reliability.

An additional issue is whether the Panel could determine a minimum number of services that AEMO must procure in each sub-network. Introducing a minimum number of services in a sub-network could lead to additional benefits that are not captured in an aggregate reliability number. Firstly, acquiring multiple sources may allow for diversity requirements (see section 5.7) to factor more heavily in the decision to acquire services. Secondly, specifying a minimum number of services in each sub-network could lead to potential SRAS providers having more confidence that their offers to provide SRAS may be acquired.

On the other hand, if the Standard required AEMO to procure a deterministic minimum amount of SRAS in each sub-network, this may lead to some SRAS providers having a greater degree of influence over the price of the service, if AEMO were not able to meet the Standard without acquiring from those potential providers.

The above considerations have the potential to increase costs to customers and generators for the provision of SRAS in a region. The Panel will need to consider the potential benefits of the additional security provided by such redundancy against the additional cost of procuring this redundancy.

Question 2 Aggregate reliability

- 1. What factors should the Panel consider in determining the level of aggregate reliability?**
- 2. Would it be appropriate for the Standard to include a minimum number of SRAS services in each sub-region? What are the costs and benefits of doing so?**

5.4 Regional variation

The Standard developed by the Panel is to apply equally in all sub-networks, unless specified by the Panel. The Panel can vary the standard between sub-networks to the extent necessary:

⁵⁸ AEMC, Final Determination – National Electricity Amendment (System Restart Ancillary Services) Rule 2015, p. iii.

- to reflect any technical system limitations or requirements; or
- to reflect any specific economic circumstances in an electrical sub-network, including but not limited to the existence of one or more sensitive loads.

Currently, there is no variation in the Standard between sub-networks.

In addition, the Panel will examine if there are specific economic reasons, sensitive loads and/or jurisdictional government requirements that may be relevant to the Panel’s considerations in respect of potential variations in the Standard between sub-networks.

The 2015 SRAS Rule amended the cost recovery of payments for SRAS.⁵⁹ Previously, SRAS costs were recovered on a national basis. Now, the costs of SRAS must be recovered from the region which benefits from that SRAS. This means that, if the Panel were to determine a more stringent Standard for a specific sub-network, only the consumers and generators in that region would face the additional procurement costs.⁶⁰

In this Review, the Panel will consider whether there are any technical limitations that would cause the Panel to apply the Standard differently in any particular sub network. For example, if the generation mix may not be capable of meeting the Standard within a specific sub-network, then there may be a case for applying the Standard differently in that particular sub network.

Question 3	Regional variation
1.	What types of technical matters or limitations are likely to impact on achieving the Standard?
2.	Are there any sub-networks in regions of the NEM where specific technical matters or limitations may be relevant to the Panel’s determination of the Standard, including any potential variations to the Standard for any specific sub networks?
3.	What types of economic circumstances or considerations should the Panel be mindful of when determining the Standard? How do they relate to the Standard?
4.	Are there any sub-networks with specific economic circumstances, such as the presence of sensitive loads, that the Panel should consider when determining the Standard, including any potential variations to the Standard for any specific sub-networks?

⁵⁹ AEMC, Final Determination – National Electricity Amendment (System Restart Ancillary Services) Rule 2015, p. v.

⁶⁰ Cost-recovery is undertaken on a region basis while any variations that may be introduced in the Standard are on a sub-network basis. Therefore, where sub-networks do not line up with regions, participants outside of the area of benefit may bear some of the additional costs.

5.5 Service to be acquired in one sub-network

The Standard must include a requirement that a SRAS is only eligible to be acquired for one sub-network at any one time. If a single SRAS was allowed to be included in the System Restart Plans for two separate sub-networks, then in the eventuality of both sub-networks being in need of restoration simultaneously, the service would not be available to one of those sub-networks.

The Panel notes that an implication of this requirement is that the Standard must be developed to be fit for the scenario whereby multiple, or all, sub-networks are in need of restoration simultaneously. That is, the Standard must be set so that the level of procured SRAS can restore a NEM-wide major supply disruption.

5.6 Determining sub-networks

The Standard must provide guidance to be followed by AEMO in its determination of sub-network boundaries, including the determination of the appropriate number of sub-networks and the characteristics required within a sub-network such as the amount of generation or load, and distance between generation centres within a sub-network. AEMO is responsible for setting the boundaries between sub-networks as part of creating the SRAS guidelines.

The current requirements in the Standard are that AEMO take into account the following factors:

- the number and strength of transmission corridors connecting an area to the remainder of the power system;
- the electrical distance (length of transmission lines) between generation centres;
- the quantity of generation in an area, which should be in the order of 1000MW or more; and
- the quantity of load in an area, which should be in the order of 1000MW or more.

Under the current AEMO guidelines, there are six sub-networks. These are North Queensland; South Queensland; New South Wales; Victoria; South Australia and Tasmania. With the exception of Queensland, the sub-networks follow the NEM region boundaries. The Queensland region is divided into two sub-networks with the division being on the South Pine - Palmwoods and Halys - Calvale transmission lines.⁶¹

AEMO considers that the borders between each of these sub-networks represents a transmission breakpoint, where the system would be likely to separate during a large scale event.⁶² In addition, each of the sub-networks have more than 1,000MW of load and generation. The largest, New South Wales, includes over 13,000 MW of load.

⁶¹ AEMO, *SRAS Guidelines*, 2014, p. 18.

⁶² AEMO, *SRAS Guidelines*, 2014, p. 17.

The Panel notes that a number of stakeholders raised concerns in submissions to AEMO about the provision of information during the preparation of the AEMO guidelines relating to boundaries of the sub-networks.⁶³

Additionally, the Panel notes that a number of stakeholders submitted to the AEMC as part of the consultation to the SRAS rule change that the Panel should have greater oversight in determination of the sub-network boundaries. However, the AEMC determined that there is no need to require AEMO to seek approval of changes to individual boundaries.⁶⁴

The Panel observe that the requirement that AEMO should seek to have in the order of 1000MW or more of load and generation in a sub-network may potentially lead to barriers in the creation of multiple sub-networks in smaller NEM regions, such as Tasmania.

Question 4 Sub-network guidelines

- 1. What factors should the Standard require AEMO to take into account when setting sub-network boundaries? How are they relevant?**

5.7 Diversity and strategic locations

The Rules require that the Standard includes guidelines for diversity and strategic locations. The existing Standard specifies that AEMO must consider four diversity requirements during the procurement of SRAS

- electrical;
- technical;
- geographical; and
- fuel.

The Interim Standard noted that diversity requirements allow independence between different SRAS sources. Creating this independence through diversity may lessen the probability that any specific circumstance could lead to a situation where the system could not be restored due to the unavailability of SRAS services.⁶⁵

As part of the Panel's 2012 review of the Standard, the Panel introduced the requirement for fuel diversity. The Panel made this amendment due to an expectation of an increase in penetration of gas-fired plant, and concern about the impact of a "gas supply event".⁶⁶

⁶³ AEMO, *System Restart Ancillary Services – Final Report*, 2014, p. 19.

⁶⁴ AEMC, *System Restart Standard Final Determination*, 2015, p. 52.

⁶⁵ AEMO, *Interim System Restart Standard*, 2006, p. 15.

⁶⁶ Reliability Panel, *Final Determination System Restart Standard*, 2012, pp. 21, 24.

The Panel notes that the requirement in the current Standard for electrical diversity requires consideration of "whether there would be a single point of electrical or physical failure". It has been noted that during a system restart, there is likely to always be points of failure, where a fault may potentially return the system to a black system state. Therefore, this provision may be ambiguous in its meaning.

There may be value for SRAS to be located physically or electrically close to strategic loads. If such a source were to be available, it could increase the probability that the specific area of the system would be restored sooner, allowing the system operator to supply energy to the specific load faster than otherwise would be the case. Therefore, the Panel may consider whether there may be benefits to include a diversity requirement that AEMO take into account specific economic loads in determining the locations of purchased SRAS in each sub-network.

However, any increased diversity requirement on AEMO could lead to a reduction in the flexibility of procurement decisions.

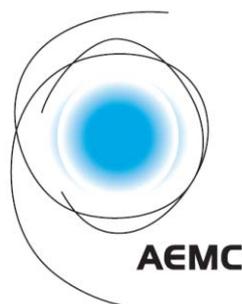
Question 5 Diversity Requirements

- 1. Do stakeholders consider the existing diversity requirements in the Standard for the procurement of SRAS by AEMO to be appropriate?**
- 2. Do the existing diversity requirements in the Standard for the procurement of SRAS by AEMO adequately create independence between different SRAS providers in the same sub-network?**

Abbreviations

AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
NEM	National Electricity Market
NER	National Electricity Rules
SRAS	System Restart Ancillary Services
TNSP	Transmission Service Provider
VCR	Value of Customer Reliability

A Terms of Reference



Review of the System Restart Standard

AEMC Terms of Reference to the Reliability Panel

30 June 2015

Introduction

These terms of reference are intended to guide the Reliability Panel (the Panel) in developing the System Restart Standard (the Standard).

As set out in clause 8.8.3(aa) of the National Electricity Rules (NER), the Australian Energy Market Commission (AEMC) requests that the Panel undertake a review of the Standard. The purpose, scope and timing for this review are set out below in these Terms of Reference. If there are any inconsistencies between the NER requirements and these Terms of Reference, the NER takes precedence.

Background

In the event of a major supply disruption, System Restart Ancillary Services (SRAS or restart services) may be used to supply sufficient energy to restart power stations in order to begin the process of restoring the power system.

The Panel is responsible for determining the Standard, which sets out several key parameters for system restoration, including the speed of restoration, how much supply is to be restored and the level of reliability of SRAS. The Australian Energy Market Operator (AEMO) then procures restart services to meet the Standard, and develops the System Restart Plan in accordance with the Standard.

On 2 April 2015, the AEMC published a final rule that made a number of changes to the SRAS frameworks in the National Electricity Market. The Reliability Panel is required by the final rule to revise the System Restart Standard as soon as practicable after the commencement of the final rule (1 July 2015), to take into account those changes.

The Panel's review and determination of the Standard must be finalised in time to allow AEMO to amend the SRAS Guidelines, and to be used by AEMO for the next

round of SRAS procurement. Accordingly, the Panel must complete its determination of the Standard no later than December 2016.

Scope of this Review

When determining the Standard, the Panel must consider whether all of the relevant requirements in the NER⁶⁷ have been met. These NER requirements are described below.

In accordance with clause 8.8.3(aa)(1) of the NER, the Reliability Panel must review and determine the SRS in accordance with the SRAS Objective.

The SRAS Objective is defined in Chapter 10 of the NER as:

The objective for system restart ancillary services is to minimise the expected costs of a major supply disruption to the extent appropriate, having regard to the national electricity objective.

Clauses 8.8.3(aa)(2) to (7) of the NER state that the system restart standard must:

- (2) identify the maximum amount of time within which system restart ancillary services are required to restore supply in an electrical sub-network to a specified level, under the assumption that supply (other than that provided under a system restart ancillary services agreement acquired by AEMO for that electrical sub-network) is not available from any neighbouring electrical sub-network;
- (3) include the aggregate required reliability of system restart ancillary services for each electrical sub-network;
- (4) apply equally across all regions, unless the Reliability Panel varies the system restart standard between electrical sub-networks to the extent necessary:
 - (A) to reflect any technical system limitations or requirements; or
 - (B) to reflect any specific economic circumstances in an electrical sub-network, including but not limited to the existence of one or more sensitive loads;
- (5) specify that a system restart ancillary service can only be acquired by AEMO under a system restart ancillary services agreement for one electrical sub-network at any one time;
- (6) include guidelines to be followed by AEMO in determining electrical sub-networks, including the determination of the appropriate number of electrical sub-networks and the characteristics required within an electrical sub-network (such as the amount of generation or load, or electrical distance between generation centres, within an electrical sub-network); and

⁶⁷ For the avoidance of doubt, any reference here to “the NER” refers to the new version of the NER that will commence 1 July 2015 and which will include the changes to the SRAS frameworks made in the final rule.

- (7) include guidelines specifying the diversity and strategic locations required of system restart ancillary services.

Considerations

In addition to meeting the above requirements which are set out in the NER, the Reliability Panel should also have regard to a number of additional matters when determining the Standard. These should include, but are not limited to, the following:

- The value of system restoration to consumers following a major supply disruption, including having regard to measures such as the value of customer reliability determined by AEMO; and
- The estimated costs of sourcing restart services.

Consultation

Stakeholder engagement will be central to the effective development of the Standard. The Panel should consult with as wide a range of stakeholders as possible, including network service providers, generators, consumers, jurisdictional governments and any other relevant bodies.

The Panel should also consider whether holding public forums and/or workshops may be helpful in facilitating more effective engagement with stakeholders.

Timing and deliverables

The Panel must carry out the review to develop the Standard in accordance with the following process:

- Give notice to all registered participants of commencement of this review and invite submissions for a period of at least four weeks.
- Publish an issues paper for consultation with stakeholders at the time of notifying stakeholders of the review. This paper should outline the key issues and questions the Panel will consider when determining the Standard.
- Publish a draft report and invite submissions for a period of at least six weeks.
- At the time of publishing the draft report, notify stakeholders that they may request a public meeting on the draft report within five business days of the draft report being published.
- If stakeholders have requested a public meeting, notify stakeholders that a public meeting will be held. At least two weeks' notice of the public meeting must be given.
- Publish a final report and submit this report to the AEMC no later than six weeks after the period for consultation on the draft report has closed.

As noted above, the Panel must complete its determination of the Standard no later than December 2016.

B Current Standard

1. Introduction

This System Restart Standard (standard) was determined by the Reliability Panel (Panel) in accordance with clauses 8.8.1(a)(1a) and 8.8.3 of the National Electricity Rules (Rules). The purpose of this standard is to provide guidance and set a benchmark to assist the Australian Energy Market Operator (AEMO) in procuring sufficient system restart ancillary services (SRAS) to meet the requirements of the National Electricity Market (NEM). This standard is effective from 1 August 2013.

2. Requirements of the standard

The requirements of the standard are specified under clause 8.8.3(aa) of the Rules, which states that (italicised terms are defined under the Rules):

“The *system restart standard* must:

1. be consistent with the SRAS objective referred to in clause 3.11.4A(a);
2. apply equally across all *regions*, unless the *Reliability Panel* varies the *system restart standard* between *electrical sub-networks* to the extent necessary:
 - (a) to reflect any technical system limitations or requirements; or
 - (b) if the benefits of adopting the *system restart standard* would be outweighed by the costs of implementing such a standard;
3. identify the maximum amount of time within which *system restart ancillary services* are required to restore *supply* to a specified level;
4. include guidelines on the required reliability of *primary restart services* and *secondary restart services*;
5. include guidelines to be followed by AEMO in determining *electrical sub-networks*, including the determination of the appropriate number of *electrical sub-networks* and the characteristics required within an *electrical sub-network* (such as the amount of generation or load, or electrical distance between *generation centres*, within an *electrical sub-network*);
6. include guidelines specifying the diversity and strategic locations required of *primary restart services* and *secondary restart services*.”

In making its determination of the standard, the Panel detailed the factors considered in its decision in AEMC Reliability Panel 2012, System Restart Standard, Final Determination, 12 April 2012. Consistency of the standard with the SRAS objective is

explained in this report and the final decision with respect to the other requirements under clause 8.8.3(aa) are outlined below.

3. Applicability of the standard in electrical sub-networks

This standard shall apply equally across all regions and electrical sub-networks.

4. Restoration timeframe

For each electrical sub-network, AEMO shall procure SRAS sufficient to:

- re-supply and energise the auxiliaries of power stations within 1.5 hours of a major supply disruption occurring to provide sufficient capacity to meet 40 per cent of peak demand in that sub-network; and
- restore generation and transmission such that 40 per cent of peak demand in that sub-network could be supplied within four hours of a major supply disruption occurring.

The restoration timeframe represents the 'target timeframe' to be used by AEMO in the procurement process. It is not a specification of any operational requirement that should be achieved in the event of a black system condition.

5. Reliability of services

Primary restart services shall have a reliability of 90 per cent.

Secondary restart services shall have a reliability of 60 per cent.

Services may be considered in combination to meet a higher level of reliability than the individual service.

AEMO will determine the manner in which reliability will be assessed, and clarify the provisions for combining services, in accordance with the requirements under the Rules.

6. Guidelines for the determination of electrical sub-networks

AEMO shall determine the boundaries for electrical sub-networks without limitation by taking into account the following factors:

- the number and strength of transmission corridors connecting an area to the remainder of the power system;
- the electrical distance (length of transmission lines) between generation centres;

- the quantity of generation in an area, which should be in the order of 1000MW or more; and
- the quantity of load in an area, which should be in the order of 1000MW or more.

7. Guidelines for specifying the diversity and strategic location of services

There shall be diversity in the SRAS procured by AEMO to provide an appropriate level of independence between the services procured. AEMO shall consider diversity of the services by taking into account the following guidelines:

- Electrical - diversity in the electrical characteristics shall be considered particularly with respect to whether there would be a single point of electrical or physical failure;
- Technological - diversity in technologies shall be considered to minimise the reliance of services on a common technological attribute;
- Geographical - diversity in geography shall be considered to minimise the potential impact of geographical events such as natural disasters; and
- Fuel - diversity in the type of fuel utilised by services shall be considered to minimise the reliance on one particular fuel source.