Interim System Restart Standard

PREPARED BY: Electricity System Operations Planning and Performance

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FINAL

APPROVED BY THE RELIABILITY PANEL

THE STANDARD IS TO GUIDE THE ACQUISITION OF SYSTEM RESTART ANCILLARY SERVICES.

Version Control

VERSION	DATE	AUTHOR	COMMENTS
1.0	03/11/2006	Chris Stewart	Initial version following Rules consultation.
Effective from 1 July 2009, *NEMMCO* changed to *AEMO* and relevant changes are made to this document.			

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Table of Contents

1. Introduction

AEMO is required by clause 11.2.1(b)(3) of the *Rules* to develop an interim *system restart standard*.[1]

Clause 11.2.1(b)(3) states:

> At any time when no *system restart standard* under clause 8.8.3[2](a)(1a) is in force, *AEMO* must develop and *publish* an interim *system restart standard* that is:
>
> (i) consistent with the requirements in clause 8.8.3(a[3]); and
>
> (ii) approved by the *Reliability Panel*
>
> and the interim *system restart standard* applies until such time as the *Reliability Panel* determines a *system restart standard*.
>
> *AEMO's* interpretation of this is that the *Reliability Panel* ought not approve the interim *system restart standard* unless *AEMO* can demonstrate that it is consistent with clause 8.8.3(aa), which states:
>
> 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 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 service*s 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*

[1] For ease of reference, terms that are defined in Chapter 10 of the National Electricity Rules are italicised.

[2] *AEMO* believes this reference is a typographical error and assumes the correct reference is to clause 8.8.1(a)(1a).

[3] *AEMO* believes this reference is a typographical error and assumes the correct reference is to clause 8.8.3(aa).

(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*.

This paper outlines *AEMO's* proposed interim *system restart standard* and demonstrates how *AEMO* believes it complies with clause 8.8.3(aa) of the *Rules*.

AEMO will conduct consultations in accordance with the *Rules consultation procedures* on the following matters in relation to the implementation of the interim *system restart standard*:

- the ***SRAS description***,
- the ***SRAS quantity guidelines***, and
- determine the boundaries of the electrical sub-networks.

2. Recommendations FOR ELEMENTS OF INTERIM STANDARD

2.1 Equality of application of the (interim) restart standard across the NEM

Sub-clauses 8.8.3(aa)(2) requires that the system restart standard must:

apply equally across all regions, unless the Reliability Panel varies the system restart standard between electrical sub-networks to the extent necessary:

6. to reflect any technical limitations or requirements; or
7. if the benefits of adopting the *system restart standard* would be outweighed by the costs of implementing such a standard;

It is noted that the *Reliability Panel* is the only party that can vary the standard between *electrical sub-networks*, subject to any variation being consistent with the standard still meeting the SRAS objective. *AEMO* does not believe it has any authority to propose an interim *system restart standard* that reflects any variation between *electrical sub-networks*. Accordingly, the elements of the interim *system restart standard* proposed by *AEMO* would, to the extent practicable, be applied uniformly across all NEM regions.

2.2 Restoration of supply to a specified level

Sub-clause 8.8.3(aa)(3) requires that the *system restart standard* must:

identify the maximum amount of time within which *system restart ancillary services* are required to restore supply to a specified level

2.2.1 Proposed element of interim standard

System restart ancillary services should be procured for each electrical sub-network sufficient to:

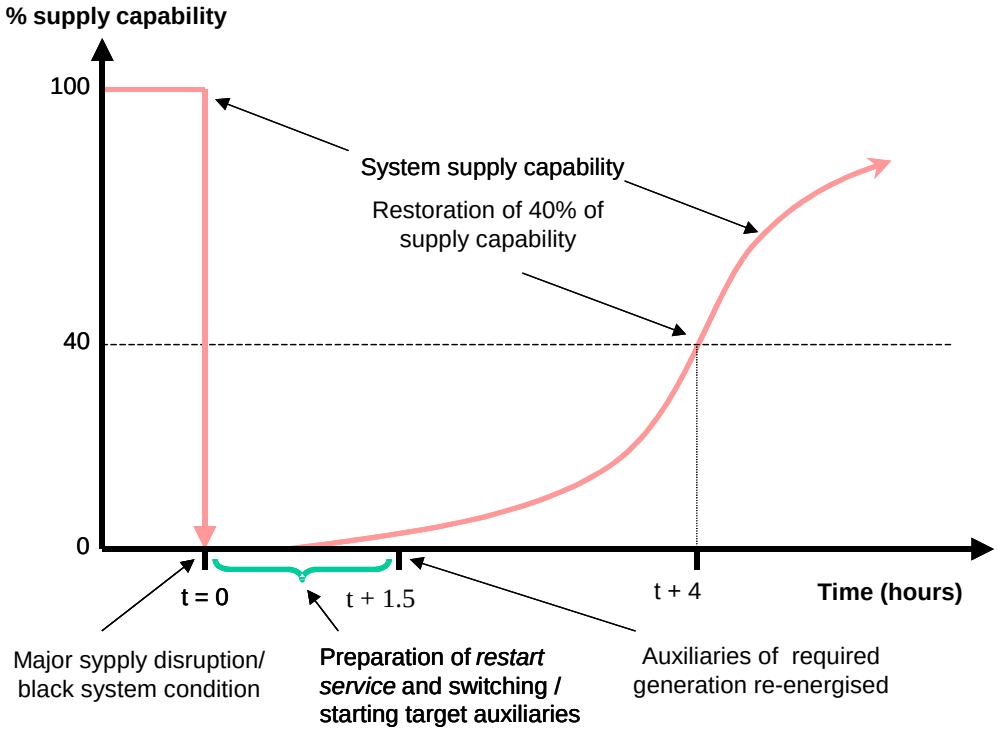
- Re-supply and energise the auxiliaries of power stations within 1½ hours of a major supply disruption occurring such that there would be sufficient capacity to meet 40% of the peak demand in the affected electrical sub-network; and
- Restore generation and transmission within the affected electrical sub-network such that 40% of the electrical sub-network's peak demand could be supplied within four hours of a major supply disruption occurring.

This can be depicted graphically as in Figure 1 which displays a schematic of the interim system restart standard that expresses restoration milestones as the percentage supply capability to be achieved at specified time durations.

Certain assumptions have been made in developing the interim system restart standard and these are included in section 3 of this paper. Key restoration parameters/milestones are;

1. an intermediate milestone relating to the re-energising of *generating unit* auxiliaries, and
2. the final restoration milestone relating to customer supply capability is expressed in terms of *peak demand* in order to provide a more stable and consistently defined target.

Figure 1: Schematic of the interim system restart standard



Given there can be no guarantees as to the exact nature of power system conditions when a *major supply disruption* occurs, time frames for restoration of supply must be capable of being met under certain system conditions. Accordingly, modelling of restart capabilities should proceed on a defined basis as outlined in Section 3, *Application of the system restart standard*.

Note that as a consequence of the modelling assumptions that are to apply, there would be a minimum of two restart services being available for each electrical sub-network.

2.2.2 Rationale

Timeframes required to restore supply capability in the *market* and the extent of restoration following the occurrence of a *major supply disruption* are affected by a number of factors:

- location (electrical distance from *load* and other *generation*) of *system restart ancillary services*;
- technology of units supplying *system restart ancillary services*;
- technology of units that are targets for *system restart ancillary services*; and
- the condition and status of *power system* infrastructure immediately following the occurrence of a *major supply disruption*.

Each of these factors creates unknowns. Although restoring customer supply capability is important, *AEMO* believes that benchmarking performance against such a parameter alone in the early phase of recovery might give a misleading impression of the potential for success (or otherwise) of restoration efforts[4]. Accordingly, the interim *system restart standard* focuses on the re-supply and energisation of the auxiliaries of available *generating* capacity as one of the required criteria.

It is also noted that *system restart ancillary service* is the capability of restarting large *generating units* following a *major supply disruption.* Therefore, inclusion of the requirement to re-supply and energise the auxiliaries of power stations in the interim *system restart standard* is consistent with the objective of procuring *system restart ancillary services*.

AEMO believes that a target of 1.5 hours to restore supply to the specified level of the auxiliaries of large *generating units* is broadly achievable with the current technologies and processes available, subject to adequate services available.

The latter phases of the restoration process focus on the outcome of re-supplying the bulk of consumers in a sufficiently timely manner. *AEMO* believes that a target to restore 40% of an affected *electrical sub-network's peak demand* supply capability from the *transmission network* within 4 hours would represent an effective benchmark because achieving 40% restoration marks a point at which most of the available *network* paths would need to have been restored. The remaining restoration would generally depend upon providing time for large *generating units* to come back up to the level of output required to achieve 100% supply capability and the need for extensive preparations to be made in the distribution system.

A conservative assessment of the timeframes achievable in a sample *electrical sub-network*, with a single system restart source capable of supplying auxiliaries of only one large *generating unit* or is shown below for demonstration of the current practice.

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[4] *AEMO* is conscious of ensuring that in formulating a standard, innovative technologies that might be very effective in assisting the achievement of desired longer term outcomes are not inadvertently precluded from consideration because of an overly prescriptive standard.

Table 1: Indicative times

INDICATIVE TIMES SINCE THE MAJOR SUPPLY DISRUPTION/BLACK SYSTEM OCCURRING	PROGRESSION OF PROVIDING AUX SUPPLIES OF LARGE *GENERATING UNITS*	PROGRESSION OF RESTORING *GENERATING UNIT* OR/TRANSMISSION CAPABILITY
0.5 hour	- Start SRAS source - Extend SRAS supply to a power station with large *generating unit(s)*	
1.0 hour	- First large *generating unit* starting	
1.5 hours	- First large *generating unit* started and loading - SRAS now available to start other large *generating units*	First large *generating unit* loading
3.0 hours	- First large *generating unit* stable, providing auxiliary supplies of third and fourth large *generating units* - Second large *generating unit* now started from the generator aux supply from SRAS	First large *generating unit* on 60%+ load with second large *generating unit* synchronised.
4.0 hours		First *generating unit* on ~100% load Second *generating unit* on ~100% load Third and fourth *generating unit*s started and on ~25% load

- Preliminary studies indicate that under certain conditions, a suitably tested and located *system restart ancillary service* could provide auxiliary supplies to start an initial large *generating unit* and subsequently further extend to supply the auxiliaries of the next

large *generating unit*, possibly at another power station, within an indicative time of 1.5 hours of a *major supply disruption* occurring.

- Preliminary studies indicate that under certain conditions, a suitably tested and located *system restart ancillary service* could restart at least four large *generating units* within four hours of a *major supply disruption* with sufficient time for two of these *generating units* to reach their full generating capacity and for two other *generating units* to reach 25% of their *generation* capacities.

The *SRAS* Quantity Guidelines must be developed in compliance with *Rules consultation procedures* and would be applied to determine the number, type and location of *system restart ancillary serv*ices for each *electrical sub-network*.

2.3 Reliability of restart services

Sub-clause 8.8.3(aa)(4) requires that the *system restart standard* must:

include guidelines on the required reliability of *primary restart services* and *secondary restart services*

2.3.1 Proposed element of interim standard

AEMO must develop and publish the ***SRAS description*** as required by Rule 3.11.4A(d) following the Rules consultation procedures. This includes the detailed description of each type of *system restart ancillary service*. The ***SRAS description*** identifies the criteria determining whether the *system restart ancillary service* is a *primary restart service* or a *secondary restart service*, the technical and the availability requirements of each type of *system restart ancillary service* and any other matters considered relevant by *AEMO*.

Reliability of Primary Restart Services

The primary restart services must be highly reliable and likely to perform in the manner intended if and when called upon to do so. Such services are required to be assessed by *AEMO* to be likely to perform on more than 90% of the occasions the service is called upon to deliver the service.

The reliability of *primary restart services* must be demonstrated by the following:

- an appropriate level of testing to be determined by *AEMO*, and
- engineering analysis undertaken by each prospective tenderer and assessed and approved by *AEMO*, in its reasonable opinion.

Reliability of Secondary Restart Services

The secondary restart services have to be sufficiently reliable and likely to perform in the manner intended if and when called upon to do so. Such services are required to be

assessed by *AEMO* to be likely to perform on more than 60% of the occasions the service is called upon to deliver the service.

The reliability of *secondary restart services* must be demonstrated by the following:

- an appropriate level of testing to be determined by *AEMO*, and
- engineering analysis undertaken by each prospective tenderer and assessed and approved by *AEMO*, in its reasonable opinion.

Combination of services to deliver higher level of reliability

Certain technologies may be more reliable than others in terms of the probability of successfully delivering a *restart service* when called upon to deliver the service. However a combination of individual *restart services* with lower reliability than required for a *primary restart service* due to their technologies would, in combination, be able to meet the required level of reliability for a *primary restart service*.

The following example is intended to illustrate this concept.

Individual versus group reliability of a restart service: an example

Assume the notional reliability requirement for a *primary restart service* is, say, 90% – that is, if subjected to repeated random tests of its restart capability, any given *restart service* would be expected to fail to deliver on less than 10% of the occasions it was called on.

There are two restart technologies, A and B.

• 'Technology A' is considered highly reliable, and if subjected to repeated random tests of its restart capability, any given unit would be expected to fail to deliver on less than 10% of the occasions it was called on.
• 'Technology B' is considered only moderately reliable and if subjected to repeated random tests of its restart capability, any given unit would be expected to fail to deliver on, say, 40% of the occasions it was called on.

If assessment of the reliability of a *restart services* was on the basis of the likely capability of any individual unit, only 'technology A' would be considered worthy of contracting as a *primary restart service*. However, if a group of three 'technology B' units could be established and offered collectively as a *restart service*, the probability of all four units failing at the same time is only 7% (40% x 40% x 40%).

Hence, a group of three 'technology B' units would meet the notional reliability requirement for a *primary restart service* of 90%.

On this basis it is noted that the combination of three *secondary restart services* with no common mode failures may be able to meet the reliability requirement for a *primary restart service*.

2.3.2 Rationale

AEMO interprets the AEMC's Determination: National Electricity Amendment (System Restart Ancillary Services and pricing under market suspension) Rule 2006 (**AEMC's SRAS determination**), as endorsing a requirement that *primary restart services* are to be more reliable than *secondary restart services*. However, no further guidance is available as to the absolute value of reliability thresholds beyond *AEMO's* suggestion that *primary restart services* be considered highly likely to perform in that manner intended, and *secondary restart services* be more likely than not to work in the manner intended.

There is no evidence that *AEMO* is aware of that would lead it to believe it is practicable to commission a study that would determine a "correct" primary or secondary restart service reliability threshold[5]. Accordingly, if numerical thresholds are to be established for the (probable) reliability of *restart services*, it must be done in a deterministic manner, with the long term interests of consumers of electricity adequately served if the community could be reasonably certain that the restart services procured on its behalf would work if and when required.

AEMO believes that a threshold of 90% expected reliability for primary restart services and a 60% expected reliability for secondary restart services meets the presume community expectations and should be reasonably achievable with current technology and processes.

Having set the required reliability thresholds, there is a further challenge in applying those thresholds to the assessment of tendered restart services. In the absence of a large number of repeated experiments, say 1,000, it is impossible to assign any objectively accurate measure of the reliability of a given restart service. In the absence of statistical information, an appropriate way of assigning a numerical measure to the reliability of a particular restart service is to apply expert engineering judgement to the facilities in question, taking account of the technologies in use and the general condition of the plant involved. Engineering experience applied in this way will allow "approximately correct" assessments of reliability to be made.

2.4 Determining electrical sub-networks

Sub-clause 8.8.3(aa)(5) requires that the *system restart standard* must:

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

[5] Section 1.3 of NEMMCO's Final report on the SRAS review covered this issue in some detail. [Document is archived]

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*)

2.4.1 Proposed element of interim standard

The *electrical sub-networks* will be determined by taking into account, but not limited by, 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*;
- a significant quantity of *generation* in an area, of the order of 1000 MW or more;
- a significant quantity of *load* in an area, of the order of 1000 MW or more.

In view of the physical nature of these criteria, it should be expected that e*lectrical sub-network* boundaries will not necessarily coincide with *region* boundaries.

Generation centres will be deemed sufficiently remote from each other to warrant consideration of separate sub-networks, if the transmission network between those centres is likely to take in excess of two hours to fully-re-energise following a major supply disruption.

AEMO will conduct a consultation in accordance with the *Rules consultation procedures* to determine the boundaries of the *electrical sub-networks,* following approval of the interim *system restart standard* by the *Reliability Panel*.

Once the boundaries of the *electrical sub-networks* are determined, *AEMO* will publish this information on its website prior to commencing a process to acquire *system restart ancillary services*.

2.4.2 Rationale

AEMO's report on the SRAS Review[6] proposed that *AEMO* take the following factors take into account and described the relevance of these factors:

- The number and strength of transmission corridors connecting an area to the remainder of the system;
- The electrical distance between groups of generation;
- The amount of generation in an area;
- The amount of load in an area.

[6] NEMMCO's Final report on the SRAS review p.45. [Document is archived]

In clarifying the guidelines that are to apply in the determination of electrical sub-networks, *AEMO* is guided by the **AEMC's SRAS determination** in which it was noted [at p.24] that, in respect of the criteria that *AEMO* proposed to apply in determining electrical sub-networks:

[NEMMCO] indicate factors that NEMMCO may take account of, rather than providing guidance to NEMMCO on, for example, how much *generation* or load is appropriate for an *electrical sub-network* and at what point the electrical distance between groups of generation is too far[7].

Current practice[8] for establishing *electrical sub-networks* sets the lower threshold for *generation* and load within an *electrical sub-network* at around 1,000 MW. In the absence of more specific guidance from the AEMC's final determination or Reliability Panel deliberations, *AEMO* believes existing practice should be reflected in the interim *system restart standard*.

The **AEMC's SRAS determination** did not provide guidance on the application of other relevant factors, and *AEMO* has interpreted silence on these matters as an indication that the remaining criteria are adequately and clearly expressed.

[7] **AEMC's SRAS determination**, p.24

[8] Details are available in the SRAS Description and Procedure developed through Rules consultation in 2005 and available on the NEMMCO website at http://www.nemmco.com.au/ancillary_services/160-0210.pdf . [Document now archived.]

2.5 Diversity and strategic location of restart services

Sub-clause 8.8.3(aa)(6) requires that the system restart standard must:

include guidelines specifying the diversity and strategic locations required of primary restart services and secondary restart services

2.5.1 Proposed element of interim standard

The following guidelines apply to specifying the diversity of *primary restart services* and *secondary restart services*:

- Electrical

  It is important that there is an appropriate degree of independence between the services, in particular regarding any potential single points of electrical or physical failure. Consideration should be given to the potential for a major power system disturbance to adversely affect more than one service.

- Technological

  Diversity of technologies should also be considered to minimise the reliance of services on a common attribute. For example, a restoration strategy may be less robust if the services all relied on gas supplies or all services were trip-to-house load.

- Geographical

  Where there is potential for a natural disaster such as a severe bad weather event or earthquake or other event to adversely effect services that are closely located by geography, consideration should be given to achieving geographic diversity.

A limitation is to be imposed of only one *system restart ancillary service* for any power station. For the purpose of this standard, the failure of a power station is a level of failure that should be reasonably catered for in this context.

The following guidelines apply to specifying the strategic location of *primary restart services* and *secondary restart services*

- The services require a range of capabilities to be effective in restoring the power system following a major power system disturbance. Key capabilities include energising parts of the network and assisting other generating units to restart. Any strategic location would be well placed both geographically and electrically to facilitate power system restoration.
- The following factors should be taken into account when considering the strategic locations of *primary restart services:*
  - complexity of the relevant parts of the network,
  - flexibility in re-configuring the relevant parts of the network,

– simplicity in establishing a path between the primary or secondary restart services and target large generating units.

In some cases there may be trade-offs between these factors. For example, a clear path may be faster to establish but it may be characterised by less flexibility.

Subject to a consideration of the above factors, a strategic location may be either within or outside an electrical sub-network where the service is required.

2.5.2 Rationale

Independence of *system restart ancillary services* is considered important to avoid the restart process from being exposed to a single point of failure – where 'single point of failure' is broadly interpreted – that could disable all system *restart ancillary services* for an *electrical sub-network*. This independence is sought to be achieved through several forms of diversity, including electrical, technical and geographical, as well as the limitation on a power station to provide only one restart service.

The effect of an adverse event may be minimized through diversity, in circumstances such as where at least either one contracted *system restart ancillary service* or one transmission corridor was not available. If there were two (or more) *independent restart services* available to each sub-network, infrastructure non-availability - to the extent indicated by the assumptions to be applied - would not leave the sub-network without an effective system *restart ancillary service*[9].

3. Application of the interim system restart standard

Time frames required to restore customer supply capability and the extent of restoration following the occurrence of a *major supply disruption* are affected by a number of factors:

- location (electrical distance from load and other *generation*) of contracted *restart services*;
- technology of *generating units* supplying *restart services*;
- technology of *generating units* that are targets for *restart services*; and
- the condition and status of power system infrastructure immediately following the occurrence of a *major supply disruption.*

In procuring *SRAS* and developing *system restart plans* and procedures, the cause of the *system shutdown* is not (and cannot be) the focus as the plan should cater for shutdowns

[9] If a group of power stations could demonstrate there were multiple independent paths to the transmission network, it is possible that they would not be subject to a common point of failure.

stemming from any cause. However, given the potential seriousness (in both social and economic terms) of *system shutdowns*, it would be prudent to develop *system restart* strategies that mitigate the effects of plausible (although low probability) modes of system failure, subsequent system conditions and the consequent effect on the restoration process. Hence, there is a requirement that the interim *system restart standard* can be met simultaneously for all *electrical sub-networks* should there be no infrastructure damage, but also that for any *one electrical sub-network*, the interim *system restart standard* can still be met even when plausible levels of damage have been sustained.

The outcomes-based standard suggests specified restoration time frames and percentages should be capable of demonstration through modelling the recovery from widespread *system shutdown* where specific assumptions are made. These assumptions relate to highly plausible infrastructure damage levels that could be sustained as part of the shutdown event – without stipulating whether the damage has caused the shutdown, or is a result of it. However, it might be argued that other post-event infrastructure conditions are equally plausible and could also be the subject of modelling assumptions, with additional or alternative modelling influencing the assessed effectiveness of prospectively contracted *system restart ancillary services*.

The power system is designed and operated to withstand the occurrence of *single credible contingency events*, and the set of multiple contingencies (*non-credible contingency events*) is very large, making prediction and assignment of probabilities of possible multiple contingency events difficult or impossible. Further, it is not practicable – or even possible – to model every single mode of failure and combination of infrastructure (non)availability likely to be associated with *system shutdowns*.

Accordingly, in applying a test as to whether the interim *system restart standard* has been met, modelling the capability of prospectively contracted system *restart ancillary services* should proceed on the basis of defined combinations of assumptions that are to apply in relation to two scenarios as described below:

Scenario 1: Total system shutdown but infrastructure remains undamaged

Assumption A

Supply is disrupted to the extent that there is an absence of voltage on all of the transmission system in all *electrical sub-networks*.

Assumption B1

All transmission and generating assets remaining intact, operational and available for service following the system disturbance that led to *system shutdown*.

Where **Assumption A** and **Assumption B1** hold – that is, the system has completely shut down, but without sustaining permanent damage to plant – the following test (Test 1) is to apply to modelling the capabilities of combinations of *restart services* prospectively procured to assist in the restoration of each *electrical sub-network*:

Test 1

Restart services are to be procured sufficient to simultaneously meet the standard in each electrical sub-network.

Scenario 2: Total system shutdown including infrastructure damage

Assumption A

Supply is disrupted to the extent that there is an absence of voltage on all of the transmission system in all *electrical sub-networks*.

Assumption B2

Non availability of either:

- any one power station contracted to provide *restart services* for a target *electrical sub-network*; or
- any one significant transmission facility[10] within a *target electrical sub-network* such that it cannot be utilised in the system restoration process,

but all other transmission and/or generating assets remain intact, operational and available for service.

> Where **Assumption A** and **Assumption B2** hold – that is, the system has completely shut down, with a defined level of damage sustained to critical plant – the following test (Test 2) is to apply to modelling the capabilities of combinations of *restart services* prospectively procured to assist in the restoration of a *target electrical sub-network*:

Test 2

Restart services are to be procured sufficient to meet the standard in the *target electrical sub-network*.

That is, services prospectively procured must meet the standard in the target sub-network, regardless of possibly not meeting the standard in other sub-networks. In applying Test 2, each sub-network is to be modelled in turn as the *target electrical sub-network*, with the nominated damage level modelled and the test separately applied to each *electrical sub-network* in the power system.

Application of the above principles suggests that the standard would not necessarily be met for the following circumstances:

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[10] If the non-availability of any transmission facility (for example, a series of lines in close proximity or on a common tower) has the potential to adversely impact, in a significant manner, the effectiveness of a *system restart ancillary service* and/or supply restoration times, that corridor would be deemed 'significant' for the purposes of modelling that *system restart ancillary service*.

for every sub-network simultaneously when Assumption A and Assumption B2 hold; or

for any sub-network should infrastructure damage be more serious than that indicated under Assumption B2.

To satisfy test 2 it is expected that there would be at least two *restart services* for each *electrical sub-network* to ensure, if one *restart service* is not available, that there is a back-up *restart service* technically capable of assisting restoration of any target *electrical sub-network.*

Events over recent years have demonstrated the propensity of the *power system* to form highly viable islands following a disturbance, rather than necessarily cascading to a full shutdown. Accordingly, there is potential for an event leading to a *major supply disruption* to be contained to a single *electrical sub-network*, thereby creating alternative sources of restoration assistance.

4. Demonstration of compliance with the Rules – the SRAS objective

Sub-clauses 8.8.3(aa)(1) requires that the *system restart standard* must:

be consistent with the *SRAS objective* referred to in clause 3.11.4A(a):

AEMO interprets the Rule provisions under which the interim *system restart standard* is prepared to require the interim *system restart standard* to also be consistent with the *SRAS objective*.

The *SRAS objective* referred to in clause 3.11.4A(a) of the *Rules* states:

The objective for *system restart ancillary services* is to minimise the expected economic costs to the *market* in the long term and in the short term, of a *major supply disruption*, taking into account the cost of supplying *system restart ancillary services*, consistent with the *NEM objective*.

As noted in the **AEMC's SRAS determination**, the SRAS Objective:

… recognises that the economic aim of providing the services is not that they should be provided in such a way as to only minimise the cost of provision in the short term but to be delivered in an economically efficient manner that minimises the overall economic cost of a major supply disruption.[11]

In developing the interim *system restart standard*, *AEMO* notes that the objectives require balancing the cost (as distinct from price) of service provision with the community benefits of the service level procured to meet the standard. However, *AEMO* also notes that the level

[11] **AEMC's SRAS determination**, p.14.

of benefit the community actually derives from setting the standard at a particular level is extraordinarily difficult or impossible to measure[12].

System shutdown is a rare event – it has not happened since the mid 1960s – with high economic impact and preparation for such an event has many characteristics of insurance (paid for but possibly never used). Accordingly, the interim *system restart standard* effectively specifies the level of insurance to be procured at a baseline level, for the vast majority of consumers and producers. The interim *system restart standard* effectively caps or limits the economic and commercial impact of a *major supply disruption* on industry participants and the broad community.

The proposed elements of the interim *system restart standard* relating to sub-clauses 8.8.3(aa)(2) to (6) are comprehensively discussed in Sections 2.1 through 2.5 above. Through the discussion in Section 2, *AEMO* believes it has presented a sound rationale for each element of the interim *system restart standard*, demonstrating that each makes a contribution to minimising the likely impact on the community of any *major supply disruption*:

- The proposals for time frames within which the *power system* must be restored to a given level (Section 2.2), establish realistic targets for competently delivered effective *restart services*. It should be noted that these timeframes will not necessarily meet the needs of each and every consumer of electricity, but consumers with needs greater than those specified in the standard would be able to make bilateral arrangements to meet their particular needs. The publication of an outcomes-based system restart standard (for the first time) puts consumers and producers of electricity in a position where they can make an informed decision on the need for special arrangements.
- The targets for the reliability of *restart services* (Section 2.3) represents thresholds that should meet reasonable community expectations regarding the probability of successful recovery from a *major supply disruption*. The specification of service reliability levels with provision for assessment and testing of claimed reliability ensures value for money.
- Proposed guidelines for establishment of *electrical sub-network* boundaries (Section 2.4) incorporate thresholds for ensuring the size of the *electrical sub-networks* are neither: so small that an unreasonable number of *restart services* need to be found; nor so large as to give discomfort to a community that it risks being inadequately covered by *restart services*.
- Guidelines with respect to diversity and strategic location of *restart services* (Section 2.5) adequately control for plausible modes of system failure that might otherwise prevent multiple *restart services* being simultaneously disabled.

On the basis of the interim *system restart standard* as proposed, *AEMO* believes the probabilistic value of lost load avoided would be minimised at a reasonable cost, provided the *restart services* procured to meet the interim *system restart standard* are efficiently and effectively delivered.

[12] See Section 1.3 of NEMMCO's Final report on the SRAS review. [Document is archived]

Compared to the status quo, the proposed arrangements represent a considerable improvement in the level of regulatory certainty offered by *SRAS* arrangements, providing a rational balance between cost and service level. The proposed standard allows fair rewards to investors in *SRAS* services, which in turn provides an environment for delivery of both short term and longer term protection to the industry, including the vast majority of consumers, against prolonged power *system shutdowns*.

On balance, *AEMO* considers the proposed interim *system restart standard* to be consistent with both the *SRAS objective* and the *NEM objective* – the proposals promote efficient use of and investment in electricity services in a way that advances the long term interests of consumers of electricity.

5. Glossary

Following is a glossary of terms used in this paper.

TERM	DEFINITION
black start capability	As defined in the Rules
black system	As defined in the Rules
connection point	As defined in the Rules
electrical sub-network	As defined in the Rules
independent (restart services)	Units with *black start capability* that do not have a reliance on common network assets (including whole sub-stations or transmission corridors) to facilitate the delivery of *restart services*
local black system procedures	As defined in the Rules
major supply disruption	As defined in the Rules
peak demand	Predicted most probable demand for the current year in each *electrical sub-network*
primary restart service	As defined in the Rules
restart service	The process of supplying sufficient energy and establishing a connection via the transmission infrastructure to restart other (large) generating units
Rules consultation procedures	As defined in the Rules
secondary restart service	As defined in the Rules
system restart standard	As defined in the Rules

system restart plan	As defined in the Rules
system restart ancillary services (SRAS)	As defined in the Rules
system shutdown	Widespread failure of supply that may (or may not) qualify as a *black system* condition
target electrical sub-network	An *electrical sub-network* that is the object of assessment as to whether prospectively procured *restart services* are capable of meeting the *system restart service standard* when assumptions A and B2 hold – see Section 5
trip to house load (TTHL)	Large generating units that can disconnect from the network through a major system incident and continue to supply their own auxiliaries or an isolated segment of system load
viable *restart service*	A feasible *restart service* that has been subjected to extensive assessment and modelling and, subject to any necessary (minor) modifications being made to NSP facilities, is deemed capable of providing an effective *restart service*