SRAS GUIDELINE
ELECTRICAL SUB-NETWORK BOUNDARIES
NSCAS TENDER GUIDELINES

DRAFT REPORT AND DETERMINATION

Published: **August 2017**

AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

NOTICE OF SECOND STAGE CONSULTATION – SRAS GUIDELINE, ELECTRICAL SUB-NETWORK BOUNDARIES, NSCAS TENDER GUIDELINES

National Electricity Rules – Rule 8.9

Date of Notice: 25 August 2017

This notice informs all Registered Participants and interested parties (Consulted Persons) that AEMO is commencing the second stage of its consultation on the System Restart Ancillary Services (SRAS) Guideline, boundaries of electrical sub-networks and Network Support and Control Ancillary Services (NSCAS) Tender Guidelines.

This consultation is being conducted under clauses 3.11.7(f), 3.11.8, 3.11.5 and 11.81.3 of the National Electricity Rules (NER), in accordance with the Rules consultation requirements detailed in rule 8.9 of the NER.

Invitation to make Submissions

AEMO invites written submissions on this Draft Report and Determination (Draft Report).

Please identify any parts of your submission that you wish to remain confidential, and explain why. AEMO may still publish that information if it does not consider it to be confidential, but will consult with you before doing so.

Consulted Persons should note that material identified as confidential may be given less weight in the decision-making process than material that is published.

Closing Date and Time

Submissions in response to this Notice of Second Stage of Rules Consultation should be sent by email to sras2018@aemo.com.au, to reach AEMO by 5.00pm (Australian Eastern Standard Time) on 26 September 2017.

All submissions must be forwarded in electronic format (searchable pdf or Word). Please send any queries about this consultation to the same email address.

Submissions received after the closing date and time will not be valid, and AEMO is not obliged to consider them. Any late submissions should explain the reason for lateness and the detriment to you if AEMO does not consider your submission.

Publication

All submissions will be published on AEMO's website, other than confidential content.

EXECUTIVE SUMMARY

The publication of this Draft Report and Determination (Draft Report) commences the second stage of the Rules consultation process conducted by AEMO in relation to System Restart Ancillary Services (SRAS) documents. AEMO procures SRAS that are available to reliably restart generation and transmission should a major supply disruption occur, such as a black system event.

AEMO is consulting on the first SRAS Guideline to be made following the Reliability Panel's December 2016 determination of the System Restart Standard (SRS)[1], applicable from 1 July 2018. This consultation also covers AEMO's determination of the boundaries of electrical sub-networks for system restart purposes and, as an incidental matter, the tender guidelines for Network Support and Control Ancillary Services (NSCAS) Tender Guidelines.

Following publication of the SRAS Guideline Issues Paper in June 2017[2], AEMO has held several stakeholder forums, met with Transmission Network Service Providers (TNSPs) and reviewed written submissions on the SRAS Guideline and boundaries of electrical sub-networks.

The new SRAS Guideline is substantially different from AEMO's 2014 SRAS Guidelines[3], reflecting changes to the National Electricity Rules (NER) and the SRS. In addition, AEMO has incorporated changes to address recommendations from the Independent Review into the Future Security of the National Electricity Market[4] (Finkel Review), and AEMO's final report on the black system event in South Australia on 28 September 2016.[5]

The most significant changes also generated the most stakeholder interest and comment in the first consultation stage. Submissions and forum discussions relevant to the subject matter of the new SRAS Guideline focused on:

- How AEMO will assess both the individual reliability of each SRAS source and the aggregate reliability of SRAS procured for an electrical sub-network, in accordance with the guidance in the SRS.
- AEMO's assumptions regarding possible transmission network damage for the purposes of procuring SRAS.
- How AEMO will test the performance of SRAS to provide adequate assurance of its availability and readiness to respond any time a major supply disruption occurs.
- The process that AEMO will follow when tendering competitively for SRAS, in particular whether an expression of interest stage is intended.
- AEMO's determination of the electrical sub-networks for Tasmania and New South Wales.
- The process for restoration of load following a major supply disruption.

AEMO has assessed these issues and concluded:

- AEMO will determine individual reliability using the factors identified in the SRS, using a combination of test results, performance data collected by AEMO, and any additional information provided by the relevant TNSP and generator. Start-up performance in particular will depend on a test conducted within the last six months. AEMO will incorporate individual reliability and

[1] http://www.aemc.gov.au/Markets-Reviews-Advice/Review-of-the-System-Restart-Standard
[2] http://www.aemo.com.au/Stakeholder-Consultation/Consultations/SRAS-Guidelines-2017
[3] http://aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Ancillary-services/System-restart-ancillary-services-guidelines
[4] http://www.environment.gov.au/system/files/resources/1d6b0464-6162-4223-ac08-3395a6b1c7fa/files/electricity-market-review-final-report.pdf
[5] https://www.aemo.com.au/-/media/Files/Electricity/NEM/Market_Notices_and_Events/Power_System_Incident_Reports/2017/Integrated-Final-Report-SA-Black-System-28-September-2016.pdf

consideration of all diversity and strategic location factors listed in the SRS, into its determination of aggregate reliability.

- AEMO will use advice from the TNSP and available outage records to determine the reliability of the transmission network during normal conditions, and notes that the diversity assessment required by the SRS is intended to account for potential network damage during conditions that may contribute to major supply disruptions.
- During each contract year of an SRAS contract period, AEMO will conduct up to two tests: one with five business days' notice by AEMO to the SRAS Provider after consultation with the TNSP, and another following any significant maintenance on the SRAS equipment.
- AEMO does not intend to routinely conduct an expression of interest phase in its SRAS procurement, but will seek to assess any new installations of black start facilities, or proposals for installation, on an ongoing basis. Where multiple competitive providers exist, AEMO will issue invitations to tender to all known SRAS providers capable of contributing to the SRS.
- The existing boundaries of electrical sub-networks across the NEM are consistent with the revised SRS and will remain unchanged at this stage.

In considering the current version of the NSCAS Tender Guidelines, AEMO has noted that several components required by clause 3.11.5(b) of the NER were in fact contained in the sample forms of request for expressions of interest and invitation to tender originally published with the guidelines determined in 2011. As these forms may be updated from time to time in the normal course of business, AEMO proposes to include these components in the guidelines document itself, while recognising that specific requirements may apply to meet the circumstances of each NSCAS procurement.

AEMO's draft determination is to make the:

- SRAS Guideline (incorporating electrical sub-network boundaries)
- NSCAS Tender Guidelines

- in the forms published with this Draft Report.

CONTENTS

1. STAKEHOLDER CONSULTATION PROCESS

As required by the National Electricity Rules (NER), AEMO is consulting on its determination of the SRAS Guideline, boundaries of electrical sub-networks and NSCAS Tender Guidelines, in accordance with the Rules consultation process in rule 8.9.

AEMO's indicative timeline for this consultation is outlined below. Future dates may be adjusted depending on the number and complexity of issues raised in submissions.

Deliverable	Indicative date
Notice of first stage consultation and Issues Paper published	1 June 2017
First round forums in each NEM jurisdiction	3-10 July 2017
First stage submissions closed	11 July 2017
Second round forums in each NEM jurisdiction	26 July – 4 August 2017
Draft Report & Notice of second stage consultation (this document)	25 August 2017
Third round forums in each NEM jurisdiction	4-8 September 2017
Submissions due on Draft Report	26 September 2017
Final Report published	7 November 2017

The publication of this Draft Report marks the commencement of the second stage of consultation.

Note that there is a glossary of terms used in this Draft Report at Appendix A.

2. BACKGROUND

2.1 NER requirements

With effect from 1 July 2015, the Australian Energy Market Commission (AEMC) amended the NER to provide for a revised regime for acquiring SRAS. The transitional rule made at that time (rule 11.81) required:

- The Reliability Panel to revise the SRS as soon as practicable after 1 July 2015, to take into account the NER amendments.
- AEMO to develop and publish the first SRAS Guideline and NSCAS tender guidelines, as soon as practicable after the AEMC publishes the SRS as revised by the Reliability Panel.

The AEMC published the Reliability Panel's determination of the revised SRS on 15 December 2016.[6] The revised SRS will apply from 1 July 2018.

AEMO is now required to develop the SRAS Guideline and the NSCAS Tender Guidelines. At the same time, AEMO also needs to review the current electrical sub-network boundaries to determine whether they remain consistent with the revised guidelines in the SRS.

AEMO is consulting on all these matters in accordance with the Rules consultation procedures in rule 8.9 of the NER.

2.2 First stage consultation

AEMO issued a Notice of First Stage Consultation on 1 June 2017, together with an Issues Paper and draft SRAS Guideline[7].

AEMO received seven written submissions in the first stage of consultation, from AGL Energy, EnergyAustralia, Energy Networks Australia (ENA), ERM Power, Hydro Tasmania, Origin Energy and Snowy Hydro.

AEMO also held meetings and forums with Consulted Persons as described in the following table:

Meeting	Date	Meeting	Audience	Location
1.	13 June 2017	TNSP Meeting 1	TNSPs	Teleconference
2.	23 June 2017	Q&A Sessions	All Consulted Persons	Teleconference
3.	30 June 2017	TNSP Meeting 2	TNSPs	Teleconference
4.	3 July 2017	Consultation Forum Round 1 - QLD	All Consulted Persons	Brisbane
5.	4 July 2017	Consultation Forum Round 1 - NSW	All consulted persons	Sydney
6.	5 July 2017	Consultation Forum Round 1 - SA	All consulted persons	Adelaide
7.	6 July 2017	Consultation Forum Round 1 - VIC	All consulted persons	Melbourne
8.	10 July 2017	Consultation Forum Round 1 - TAS	All consulted persons	Hobart
9.	26 July 2017	Consultation Forum Round 2 - QLD	All consulted persons	Brisbane

[6] Reliability Panel, Review of the System Restart Standard, Final Determination, 15 December 2016, Sydney
[7] System Restart Ancillary Services Guideline 2017, Available at: http://aemc.gov.au/Rule-Changes/System- Restart-Ancillary-Services http://www.aemo.com.au/Stakeholder-Consultation/Consultations/SRAS-Guidelines-2017

Meeting	Date	Meeting	Audience	Location
10.	27 July 2017	Consultation Forum Round 2 - NSW	All consulted persons	Sydney
11.	28 July 2017	Consultation Forum Round 2 - TAS	All consulted persons	Hobart
12.	31 July 2017	Consultation Forum Round 2 - VIC	All consulted persons	Melbourne
13.	4 August 2017	Consultation Forum Round 2 - SA	All consulted persons	Adelaide

Copies of all written submissions (excluding any confidential information) have been published on AEMO's website at: http://www.aemo.com.au/Stakeholder-Consultation/Consultations/SRAS-Guidelines-2017

Minutes of meetings with TNSPs have been provided to the attendees at those meetings.

The main issues raised at consultation forums were summarised in question and answer format and provided to all attendees.

3. SUMMARY OF MATERIAL ISSUES

The key material issues arising from the proposal and raised by Consulted Persons cover the matters summarised in the following table:

No.	Issue	Raised by
1.	Individual Reliability – determination of individual reliability	**ENA, ERM, Hydro Tasmania, Snowy Hydro**
2.	Individual Reliability – availability of SRAS equipment	**ERM**
3.	Individual Reliability – Start-up Performance	**Snowy Hydro**
4.	Individual Reliability – transmission component reliability	**ENA, ERM**
5.	Aggregate Reliability – determination of Aggregate Reliability	**EnergyAustralia, ENA, ERM, Hydro Tasmania, Origin**
6.	Aggregate Reliability – Diversity (electrical, geographic, fuel source)	**ENA, ERM, Hydro Tasmania**
7.	Aggregate Reliability – Strategic location	**ENA, ERM, Hydro Tasmania**
8.	Aggregate Reliability – transmission network assumptions	**ENA, ERM, Hydro Tasmania**
9.	SRAS testing	**AGL, EnergyAustralia, ENA, ERM, Hydro Tasmania, Origin, Snowy Hydro**
10.	Modelling and Assessment – stakeholder engagement and data requirements	**ENA, Snowy Hydro, CS Energy, Ecogen**
11.	Procurement process – EOI, contracting of prospective sources in advance, contract duration, resolution of SRAS shortfall	**EnergyAustralia, AGL, SA Government, ERM, Hydro Tasmania, TasNetworks**
12.	Boundaries of electrical sub-networks	**EnergyAustralia, ERM, Hydro Tasmania, Origin, Snowy Hydro, ENA, Tasmanian Government**
13.	Other - Customer Load restoration	**Hydro Tasmania, TasNetworks**
14.	Other – elements of revised SRS	**Hydro Tasmania, Tasmanian Government**
15.	Other – System restart plans and procedures (matters outside of scope)	**Queensland Government, Tasmanian Government**

A detailed summary of issues raised by Consulted Persons in written submissions, together with AEMO's responses, is contained in Appendix B.

4. DISCUSSION OF MATERIAL ISSUES

4.1 Individual Reliability

4.1.1 Issue summary and submissions

The SRS requires AEMO to assess the individual reliability of each SRAS selected for an electrical sub-network, as part of its determination of whether the specified aggregate reliability of SRAS for that electrical sub-network will be met. The SRS states that the individual reliability of an SRAS must incorporate the expected:

- Availability of the service.
- Start-up performance.
- Reliability of transmission components between the SRAS source and the first transmission substation[8] to which it is connected.

In addition, AEMO proposed in its Issues Paper to include two further factors to address reliability issues presented by a 'single point of failure' within an SRAS source:

- A redundancy factor.
- An additional operational reliability factor.

Submissions received on individual reliability are outlined below.

SRAS equipment availability

ERM submitted that the assessment of reliability should include a historical assessment of unit return to service performance, and a timely resynchronisation factor, which could be calculated based on data where a unit has come out of service for any reason and been resynchronised within 24 hrs.

ERM submitted that an assessment of the sizing and capability of an initial energy source should be done, including the level of redundancy contained in this source. ERM considered that the number of physical generating units offered as available as an SRAS source is particularly important for trip to house load (TTHL) sources.

Start-up performance

Snowy Hydro submitted that the start-up performance of the SRAS source is the most critical element in the assessment of its overall reliability, commenting that the value of system restart sources decreases exponentially with decreasing start-up reliability.

During the SRAS consultation forums, clarification was sought on whether start-up performance would be based solely on the outcomes of SRAS tests, or whether AEMO would look at historical performance data.

Transmission component reliability

ERM considered that, in assessing network connection and flow paths, a unit connected via a single circuit breaker and single network connection to one other generator would have less redundancy, and hence lower reliability, than a generator connected by a double bus double breaker or breaker and a half-connection arrangement and multiple network flow paths to multiple generators. In assessing the

[8] In some regions the term substation is used. In others this may be the terminal station or the power station switchyard

network availability, the calculation should include both in-service trips, time out of service and failed attempts to energise any network component in the flow path.

Weighting of factors

The Energy Networks Association (ENA) submitted that some form of weighting of these three factors would be needed, and requested elucidation of the process. ERM offered a suggested formula and worked example for an individual reliability calculation.

4.1.2 AEMO's assessment

AEMO understands that the purpose of assessing the reliability of an individual SRAS is to determine the probability that it will deliver its service as intended. With a focus on this objective, AEMO has assessed the comments in submissions and considered how concepts of reliability, availability and maintenance can be meaningfully applied to the determination of individual reliability.

Reliability and availability have in some contexts been used interchangeably in the past. A definition of each is therefore helpful in determining individual reliability. For these purposes AEMO considers that:

- Availability is a system's ability and readiness to perform a function at any point in time (and includes considerations like maintenance).
- Reliability is the probability that a system will operate without failure.

Consistent with these definitions and the revised SRS, AEMO considers that the reliability of an individual SRAS source ('SRAS individual reliability') should be assessed on the basis of:

- Composite reliability of the SRAS equipment, being the product of:
    - 'SRAS Equipment Availability' (availability of the equipment up to the transmission network connection point).
    - 'SRAS Equipment Reliability' (incorporating expected start-up performance).
- 'Transmission Component Reliability' (reliability of the transmission components between the SRAS equipment and the first transmission substation or switchyard to which it is connected).

Illustrative examples of an SRAS individual reliability calculation are provided in Appendix C.

SRAS Equipment Availability, SRAS Equipment Reliability and Transmission Component Reliability are explained under the respective headings below.

SRAS Equipment Availability

SRAS Equipment Availability is an assessment of the expected percentage of time that the SRAS equipment is operationally capable of delivering SRAS.

This accounts for time that SRAS equipment is unable to deliver SRAS for any reason, including corrective and preventative maintenance, and any outage (whether or not on the equipment itself) that prevents the SRAS equipment from operating to deliver SRAS.

Prospective and contracted SRAS providers will be asked to advise AEMO of their historical and expected SRAS Equipment Availability. This advice must include outage assessments for all major plant items comprising the SRAS equipment. Major plant is expected to include items such as emergency diesel generator, station service transformer, generating unit, circuit breaker, other auxiliary equipment needed to start up, and unit transformer.

The advice should also include return-to-service and resynchronisation performance data.
Illustrative examples of an individual reliability calculation are provided at Appendix C.

In assessing SRAS Equipment Availability, both for procurement and contract performance monitoring, AEMO will consider SRAS equipment available when it meets the individual defined availability requirements appropriate for that service. In general, this will based on:

- One or more of the alternative units[9] that can provide SRAS being available.
- All equipment that is needed for any alternative unit to deliver SRAS being available.
- The SRAS equipment being 'in date' for testing[10].

SRAS agreements will reflect the detail of SRAS availability requirements and reporting requirements for contracted SRAS.

SRAS Equipment Reliability

AEMO notes the significance of start-up performance for individual reliability, as well as the difficultly in reducing this assessment to a formula that can be equitably applied to all SRAS sources, particularly those for which AEMO does not have a history.

AEMO initially considered the possibility of developing a formula to recognise historical performance (e.g. a ratio of successful starts to total start-up attempts). On further consideration and discussions with the AEMC and at forums, AEMO has concluded there is no evident formula for start-up performance that will produce equitable and reasonable assessments across both new and established SRAS sources. AEMO has concluded that start-up performance must be established by a recent test that meets the SRAS Guideline requirements, as follows:

- For currently procured SRAS services, start-up performance will generally be determined by the latest SRAS test (no more than 6 months old).
- For potential SRAS services, start-up performance will be demonstrated by an SRAS test prior to procurement. For the July 2018 procurement process, SRAS that is not currently contracted (whether or not it has been a contracted source in previous periods) must be tested before AEMO awards the SRAS contracts.
- SRAS Equipment that fails two test attempts will not generally be considered for an SRAS contract.

For procurement purposes, and ongoing contract performance monitoring if relevant, the assessment of SRAS Equipment Reliability will also take into account (in addition to start-up performance):

- Points of Failure. Single points of failure / single component dependencies within SRAS equipment (referred to in the Issues Paper as a redundancy factor).
- Other factors affecting reliability (referred to in the Issues Paper as an operational reliability factor):
    - Component age and condition.
    - Fuel storage and supply arrangements.
    - Previous SRAS experience.

These will be determined based on the appropriate application of good engineering principles rather than a defined formula, because each SRAS source must be assessed on its specific circumstances.

The single point of failure assessment will include a reliability calculation of the plant elements that are material to providing the SRAS. This assessment will cover all major plant items comprising the SRAS equipment (as described above for SRAS Equipment Availability). Examples of reliability assessments are provided in Appendix C.

AEMO's assessment of these factors will be informed by information provided through the tender process, as well as local black system procedures, generator registration information, and relevant performance standard data.

[9] This may be an agreed minimum number of units depending on how the source availability is determined.
[10] 'in date' for testing means the equipment has successfully passed the most recent SRAS test and is not overdue for testing.

Transmission Component Reliability

The inclusion of transmission component reliability 'up to the first transmission substation' (terminal station/power station switchyard) identifies that the capacity of an SRAS source is uniquely defined by all plant and systems upstream of the first transmission substation, and extends beyond the connection point of a generator to the transmission system. To reflect this, AEMO intends to:

- Where relevant, identify the contractual Delivery Point for SRAS separately from the connection point that generally delineates the asset boundary with the transmission system.
- Determine the transmission component reliability between the connection point and the first transmission substation/terminal or power station switchyard (which is often the Delivery Point), based on assessments provided by the TNSP and reviewed by AEMO.

AEMO will seek assistance from TNSPs to advise on the reliability of these transmission components, based on their engineering assessment. That may take account of a range of matters including historical performance, technical characteristics, age or redundancy of components.

In assessing individual reliability, AEMO will not make any assumptions about the condition of these dedicated transmission components as a result of any event that may have led to a black system. The SRS does not require this and it would be impossible to make any reasonable assumptions about that possibility. In this regard AEMO notes that, in its economic assessment, the Reliability Panel[11] assumed no impact of transmission damage on the restart or restoration processes, because NEM transmission networks generally have sufficient redundancy to provide alternative electrical paths to generating units in an electrical sub-network. The Reliability Panel noted: "setting a Standard that catered for all possible multiple transmission network elements would be impractical and, if attempted, would lead to very high SRAS costs." However, the 'single point of failure' component of aggregate reliability was specifically added to the SRS by the Reliability Panel to appropriately account for a potential impact on the transmission system of conditions that may trigger a black system event. This is discussed in section 4.2.

4.1.3 AEMO's conclusion

AEMO's draft determination is to incorporate the factors contributing to individual reliability in the SRAS Guideline as follows:

- SRAS Equipment Availability, determined as the percentage of time that the SRAS Equipment is, or is expected to be, capable of delivering SRAS, based on advice from the SRAS provider and including assessment of single component dependencies and any other factors affecting reliability.
- SRAS Equipment Reliability, including start-up performance based on a recent SRAS test, engineering, assessment of single component dependencies and any other factors affecting reliability.
- Transmission Component Reliability determined by the relevant TNSP's engineering assessment of its transmission system equipment between the SRAS equipment and the first transmission substation/terminal station or power station switchyard.

[11] Reliability Panel, Review of the System Restart Standard, Final Determination, at page 48

4.2 Aggregate Reliability

4.2.1 Issue Summary and submissions

Aggregate reliability is a new term introduced by the AEMC Reliability Panel in the revised SRS to apply from 1 July 2018. In assessing the potential of an SRAS source to satisfy the aggregate reliability requirements, AEMO must now consider the following factors:

1. SRAS individual reliability as discussed in section 4.1.
2. Diversity (electrical, geographical and fuel source).
3. Strategic location of SRAS.

AEMO identified in the Issues Paper that it was considering options for the combination of these factors in a calculation to determine aggregate reliability, and welcomed suggestions on these matters.

Submissions received in relation to aggregate reliability included the following comments:

- It may be prudent to consider/set minimum availability or reliability thresholds for individual SRAS as part of the procurement process.
- AEMO and TNSPs should jointly develop the approach used to determine aggregate reliability.
- Clarification was requested on whether aggregate reliability will take into account both credible and non-credible events.
- It was suggested that AEMO's calculation should allow for the probability that multiple SRAS sources may fail simultaneously.

Specific issues in relation to each element of aggregate reliability (other than individual reliability) are outlined below.

Diversity (Electrical, Geographical and Fuel source)

The SRS requires AEMO to incorporate an assessment of the impact of diversity of the SRAS by taking into account electrical, geographical and energy (fuel) source diversity considerations. It further elaborates that in accounting for electrical diversity, AEMO should consider the failure of any single significant transmission element, such as a single line or corridor downstream of the first transmission substation in the restoration path.

Energy Networks Australia (ENA) supported including the state of the transmission system in the reliability assessment, but noted that determining whether or not transmission infrastructure is intact or feeders are effective and operational can be quite problematic in the sort of conditions (e.g. bushfires, cyclones/tornadoes) that can initiate 'system black' events.

ENA submitted that AEMO must include the ability to restore significant customer load from the SRAS source(s) and not confine the application of SRS clauses 8 and 9 to the electrical diversity of restart sources only. For example, ENA says it is insufficient for AEMO to procure SRAS sources in a generation-rich area with the ability to meet the standard, if that generation cannot facilitate power system restoration because of a vulnerable transmission corridor connecting to load.

ERM submitted that SRAS sources should be provided from diverse geographical locations (each with an individual and discrete network flow path to other generators), a diverse set of source types (including a mix of TTHL and other sources), and allow for diversity in energy fuel source (ensuring multiple sources are not dependent on a single fuel source, with sources capable of gas or liquid fuel operation being preferable to a gas-only source).

Strategic Location

The SRS provides guidance on how the strategic location of SRAS shall be determined.

As noted above, ENA submitted that the ability to restore customer load from each SRAS source should feature in this assessment.

4.2.2 AEMO's assessment

General observations

In the Issues Paper and at its forums, AEMO called for submissions on the way in which the assessment (of aggregate reliability) should be performed. This is the most challenging aspect of implementing the SRS. AEMO does not believe it can be reduced to a formula or even a series of formulas.

AEMO does not intend to exclude technically-capable black start facilities from offering to provide a service based on their individual reliability alone. However, if selected and contracted, an SRAS provider's contract will specify minimum availability/reliability requirements (based on the SRAS offer and accepted by AEMO) that must be met for the duration of the contract. This is critical because AEMO will have assessed the aggregate reliability of all the procured SRAS for an electrical sub-network based on these assumptions of individual reliability. Any reduction in individual reliability levels in the contract period can result in a failure to meet the SRS.

AEMO is keen to continue its engagement with TNSPs during the final stage of consultation on the SRAS Guideline, and when performing its assessments of aggregate reliability of proposed SRAS during a procurement process. Recognising that reliability assessments should be conducted as a whole-of-network exercise as far as practical, AEMO proposes to include in the SRAS Guideline a set of principles for assessment, based on good engineering practice, rather than detailed reliability measures. AEMO and TNSPs will need to identify which parts of the network are more susceptible to failure than others in assessing the value of potential SRAS sources that will be located at different points to restore supply across the electrical sub-network. This seems preferable to performing assessments targeting only the restart paths of sources that are currently considered likely. During the first stage of this consultation, AEMO has held collective and individual meetings with TNSPs, outside of consultation forums, to discuss these matters.

AEMO makes the following observations in response to ERM's suggestions for accounting for transmission failures:[12]

- In terms of procurement, the SRS reliability assessment must take into account the possibility of a single major transmission element failure. In operational terms (i.e. planning restart paths), these matters are discussed and managed at the regional System Restart Working Groups level where AEMO, TNSPs, DNSPs and now regional Jurisdictional System Security Coordinators (JSSCs) will be represented. The system restart plans/procedures consider and provide for alternate restart paths where feasible. As recognised in the final determination, AEMO clearly cannot procure SRAS to cover every permutation/combination that may cause a black system.
- It is unlikely AEMO will impose any maximum requirement for the number of network elements, due to the need to maximise the number of potential SRAS sources. However AEMO recognises that a larger number of potential points of failure will reduce the value of an SRAS source in terms of its reliability. AEMO considers this to be part of the SRS diversity requirement.

[12] These submissions were made in relation to the determination of electrical sub-networks (see section 4.6.1), but are relevant to AEMO's determination of aggregate reliability

Diversity (Electrical, Geographical and Fuel source)

The failure of any single major transmission element is always considered a credible contingency, irrespective of the cause. As well, the aggregate reliability assessment will take into account transmission corridors that may be susceptible to interruption due to a single event e.g. vulnerable transmission lines. AEMO considers that this is consistent with the electrical diversity criteria in the SRS. It is not thought that AEMO should account for more than one contingency, unless as part of an identified susceptible transmission corridor.

AEMO's operational procedures will deal with the failure of multiple transmission components. In assessing electrical diversity, AEMO will account for single points of failure shared by different potential SRAS sources for an electrical sub-network, e.g. the aggregate reliability of two sources will be lower if they share the same single transmission corridor than it would if they had different paths.

The scope of the SRS does not include restoration of load. However, in procuring SRAS to restore the megawatt (MW) level of supply specified in the SRS, AEMO must of course consider single points of failure that could prevent it from meeting the SRS and AEMO's power system security responsibility under NER 4.3.1(p). AEMO understands the example presented by ENA in its submission to refer to the Tasmanian network, and will discuss specific concerns with TNSPs individually in developing the network reliability assessments.

AEMO will not procure SRAS with the intent of providing a greater degree of redundancy of sources or separation of transmission paths than the SRS requires. To do so would be contrary to the NER.

Strategic Location

AEMO notes that the SRS does not indicate the significance to be attributed to strategic location in the selection of SRAS. AEMO recognises the value of the location of SRAS in energising the transmission network and assisting other units to restart.

AEMO particularly applies this value to 'Stage 1' of the SRAS process as described by the Reliability Panel.[13]

AEMO will determine the value of the strategic location in consultation with TNSP and SRAS providers. This determination may be used as a differentiator between sources that are technically compliant and otherwise comparable. For example, if both Source A and Source B satisfy the SRS requirements (Table 1 in the SRAS Guideline) and the technical requirements (section 3.3 of the SRAS Guideline) but Source A is closer to a major generation centre than Source B, then Source A would be assigned a higher value in AEMO's evaluation.

4.2.3 AEMO's conclusion

AEMO's draft determination is to incorporate the factors contributing to aggregate reliability in the SRAS Guideline as follows:

- SRAS individual reliability (see section 4.1).
- Diversity. This will be determined by comparing the relative electrical, geographical and fuel source diversity of the proposed (or procured) SRAS sources against each other, using advice from TNSPs and the relevant generators where appropriate.
- Strategic location of SRAS. This will be determined based on advice from SRAS Providers and TNSPs and will serve as differentiator between potential SRAS providers.

[13] Reliability Panel Final Determination p 21, section 2.1.5 - Stage 1 is described as the phase covering restarting of the system. The SRS specifies a level of generation and transmission capacity to be available at the end of stage 1 of the restoration process

4.3 SRAS Testing

4.3.1 Issue summary and submissions

The AEMC's Reliability Panel noted in its final determination that:

> *"testing of SRAS capability is an integral part of the restoration process and is subject to both SRAS Guidelines and other contractual obligations between AEMO and SRAS Providers. Full testing of a restart service can be difficult as it can involve taking transmission elements out of service".*

The Reliability Panel recommended that SRAS providers and TNSPs cooperate more fully to identify opportunities to fully test the operation of restart services when this involves normally 'in service' transmission elements and/or the subsequent generation units in the restoration path. For example, it may be possible to perform a more comprehensive test of a restart service when the associated transmission elements and/or generation are being returned to service following a planned outage.

For the current SRAS procurement, the SRAS testing period is nominated by the SRAS provider and tests are typically performed fairly close to the end of each financial year. In an effort to implement a more rigorous testing regime, AEMO proposed is its Issues Paper that there be two SRAS tests, one initiated by AEMO on not less than 24 hours' notice. AEMO's rationale was that, whenever advised as available, any SRAS source must be ready to provide SRAS without delay and realistically, considering a major supply disruption will occur with little or no notice.

Through feedback from SRAS consultation submissions and forums, stakeholders generally supported a greater level of testing in principle, but identified the following concerns:

- 24 hours may not be enough time for SRAS providers to ensure their operational position is protected when testing SRAS equipment. AGL proposed that the SRAS Guideline adopt a mechanism to give the SRAS operator a right of reply, e.g. ability to request a deferral on reasonable grounds.
- A number of stakeholders submitted that 'spot tests' should not be scheduled during peak periods in order to minimise the market impacts of these tests, in addition to any potential commercial implications for an SRAS provider. It was also noted that weather conditions at certain times of year can increase tripping or capacity reduction risks. Origin noted AEMO's intent to have regard to market and system conditions, and encouraged open collaboration with SRAS providers. Hydro Tasmania noted that the draft Guideline did not define how AEMO would consider market and power system conditions, including the SRAS providers' commercial interests.
- Short notice testing can create both costs and risks for TNSPs, customers and generators and it is not clear how AEMO intends to address these. ENA suggested measures such as direct payments or indemnities to enable cost recovery for additional testing. ENA also suggested that the AER be asked to provide 'in principle' support indicating that TNSP participation in tests will be immune from financial penalties associated with their Service Target Performance Incentive Scheme (STPIS).
- ERM proposed the SRAS contract include separate cost recovery for planned and short notice tests, with a formula referencing the regional reference price to recover the market costs component. Snowy Hydro noted the costs of a short notice test will vary depending on the characteristics of the restart source, where it is located in the transmission network, and exposure to financial contracts.
- Hydro Tasmania observed that configuring the network for testing and arranging isolations at such short notice could be detrimental to system security. Several submissions also highlighted

the need for co-ordination between multiple parties, requiring a clear understanding of roles and responsibilities, and the need to isolate plant unrelated to the tests.

- In relation to the need for advance consultation with the relevant TNSP, Hydro Tasmania noted that the SRAS provider is contractually liable to undertake the test but may be relying on a TNSP's switching. If the TNSP cannot facilitate the testing at short notice then the SRAS provider should not be penalised. Origin raised a question on participant compliance with clause 5.7.5 of the NER, under which a generator is required to give the NSP 15 business days' notice of planned testing requiring changes to the normal operation of equipment relating to a connection point.
- In relation to the extent of testing, ERM supported the proposal for end to end testing under simulated system black conditions, from loading representative of expected load at peak system demand. Following resynchronisation, ERM suggested that AEMO specify the steps for loading in real time, to simulate the most likely variations in loading during restoration, including unexpected decreases in loading. Origin said that the SRAS Guideline should indicate the level and extent of the tests to be employed, including items such as required equipment, identification of affected third parties and the type of generator test.

Based on submissions received and feedback in forums, there appears to be broad consensus around the following points:

- There is acknowledgment of the additional performance certainty achieved by a second test, but this comes with a cost. In addition to the direct costs associated with conducting the test, a second test will increase the physical impact on some types of plant, particularly for tests involving a trip from a full load.
- AEMO and TNSPs need to liaise closely in advance to facilitate conduct of the tests, address regulatory notice periods, and determine scheduling windows that are expected to have minimal system and market impacts, and therefore lower commercial risks for participants.
- 24 hours' notice is too short for SRAS providers to make the necessary organisational arrangements at reasonable cost, recognising this is a test situation and making some allowance for normal demands. Only Hydro Tasmania formally proposed an alternative notice period, suggesting AEMO consider allowing one week.

4.3.2 AEMO's assessment

Notice of Testing

AEMO recognises the impact that short-notice testing would have on generators and TNSPs. AEMO also acknowledges the competing need for a greater level of assurance that SRAS capability is ready for any major supply disruption whenever it occurs (as identified in the Reliability Panel's final determination of the SRS and AEMO's final report on the black system event in South Australia).

AEMO in its Issues Paper noted the need to minimise the system and market impact of testing. AEMO proposes specifying measures to mitigate these impacts for SRAS providers, to include restrictions on timing and prior liaison between AEMO and the TNSP. AEMO acknowledges that a longer notice will allow avoidable costs to be minimised and appropriate staffing levels to be organised. However, AEMO's key objective is to verify that SRAS equipment, procedures and training is constantly maintained at a level necessary to maximise the chances of responding correctly to a disruption that can occur at any time. As such, testing is a vital system security measure and cannot be done at the provider's convenience.

The SRAS Guideline will include reasonable parameters for the timing of the AEMO-nominated test, including the time of the year and other matters it will take into account in consultation with the TNSP.

With regard to notice to, and liaison with, TNSPs, AEMO's early and ongoing consultation with TNSPs is essential for system security purposes and to minimise impacts on the market as a whole. AEMO will incorporate this requirement in future reviews of Outage Assessment procedures and the System Restart Overview procedure. AEMO will work with TNSPs to identify periods suitable or unsuitable for testing throughout the year. For example, in most regions where maximum demand occurs in summer, AEMO will not schedule an SRAS test during this period. For Tasmania where maximum demands normally occur during winter, testing will not be scheduled in that period, or in periods of high dam inflows. In all cases, power system security will always take priority, and this might require the rescheduling of any notified test.

AEMO has revised its proposed SRAS testing regime to provide for testing to occur:

- After a period of maintenance where any major components of the SRAS equipment have been out of service for at least seven days.
- No more than once annually, at a date and time nominated by AEMO with no less than five business days' notice to the SRAS provider. AEMO will liaise with TNSPs in each region to select a minimum of four one-week periods during the financial year where this test may occur, having regard to market and power system conditions.

Cost of Testing

As in previous years, potential SRAS providers may specify a testing charge, or a method for determining a charge, in an SRAS tender. AEMO considers that the parameters included in the draft SRAS Guideline should enable providers to determine a charge that reflects their expected cost and risk. AEMO notes there has been no change to the NER provisions that require NSPs to participate in testing, and entitle them to recover the costs of doing so from SRAS providers. These arrangements will be a matter for negotiation between those parties, and AEMO has no authority to either provide indemnities or make direct payments to TNSPs.

AEMO has reviewed the provisions of the current STPIS for transmission, and considers that outages required for the purposes of SRAS testing would be excluded from the market impact component of the scheme under paragraph 3, and in some cases paragraph 4 of the specified exclusions. However, this is of course a matter for the TNSPs to satisfy themselves on. Should TNSPs wish to arrange a discussion with the Australian Energy Regulator (AER), AEMO would be happy to participate or provide any necessary clarification.

Scope of Testing

AEMO notes both the importance and the complexity of end-to-end testing. The configuration of each SRAS connection needs consideration to identify challenges to testing.

In both the Reliability Panel's final determination and AEMO's final report on the South Australia black system event, a high degree of verification is important to providing assurance of SRAS capability. To this end, each SRAS test should include an 'end-to-end' demonstration of SRAS capability, including energising as far as the nearest substation.

To provide appropriate assurance of all plant that forms part of SRAS equipment, where redundancy exists within an SRAS source, each component of the plant should be tested on a rotational basis, e.g. where an SRAS is provided by 'one of three' units, each of these units will be tested over the course of the contract, rather than testing the same unit each time. These details will be included in individual SRAS contracts where relevant.

To assist the 'short notice' testing and to minimise differences between presumed and actual black start conditions, SRAS providers will be required to submit test plans at the beginning of a contract period, for approval by AEMO.

4.3.3 AEMO's conclusion

After review of the feedback received from participants, AEMO has reviewed its position on testing during an SRAS contract, and its draft determination is that there will be up to two tests per contract year:

- One with five business days' notice by AEMO, after prior consultation with, and notice to, the relevant TNSP.
- One after a period of maintenance where any major components of the SRAS equipment have been out of service for at least seven days.

The draft SRAS Guideline includes parameters designed to avoid threats to system security and minimise known impacts to participants as far as practicable, recognising that these cannot be too restrictive if they are to achieve the objective of increasing assurance that SRAS sources are 'always ready'.

AEMO is not proposing any material changes to the scope of tests and associated requirements and procedures in the draft SRAS Guideline as published with the Issues Paper. Tests will comprise end-to-end testing of start-up and re-energisation capability.

4.4 Modelling and Assessment

4.4.1 Issue summary and submissions

AEMO's Issues Paper and accompanying draft SRAS Guideline (clause 4) contained requirements and principles for AEMO's proposed modelling and assessment of SRAS capability, including:

- Information AEMO needs for its modelling and assessment.
- Initial qualification, to identify all the proposed services that demonstrate compliance with the SRAS capability requirements in clause 3.2 to AEMO's reasonable satisfaction.
- Power system studies, to model the expected contribution of an SRAS to energising the auxiliaries of other power stations and rebuilding the power system in an electrical sub-network sufficient to meet the SRS (including aggregate reliability).
- Selection of SRAS, from the identified list of service or combination of services that meets the SRS requirements for each *electrical sub-network.*

ENA submitted that its members will work with AEMO to provide additional data and information to model alternate re-energisation paths, giving due consideration to both the timing and cost-effectiveness of doing so. ENA understands that such alternative paths would be at the initiation of the relevant TNSP involved.

Snowy Hydro notes the Reliability Panel's recommendations in its final determination on the SRS, for AEMO to increase engagement with key stakeholders, such as network service providers, in its consideration of key elements relevant to its procurement of SRAS. Snowy Hydro particularly highlighted the importance of engagement with TNSPs who have intimate knowledge of the practicalities of switching transmission and distribution network elements.

Various participants sought advice during the consultation forums on whether data provided to AEMO as part of the generator technical performance standards (GPS), including R1 and R2 data, provide the SRAS information AEMO requires for modelling. There were also questions about whether SRAS generators needed to provide further data if there have been no changes to protection and control systems from the data last provided to AEMO for SRAS assessment.

4.4.2 AEMO's assessment

AEMO has actively sought engagement with TNSPs in each NEM region throughout the consultation process, and will continue to do so throughout both the finalisation of the SRAS Guideline, as

appropriate through the procurement process, and of course in determining regional restart plans and procedures.

AEMO notes that GPS data provides some, but by no means all, data required for SRAS assessment. There are currently no GPSs specific to restart capabilities. AEMO needs to assess the individual black start capability and model restart paths from the relevant generating unit connection point into the network to restart other generation. AEMO collected significant data in the last SRAS procurement process. AEMO will need to obtain similar data for potential new SRAS sources, and also needs to know if existing generator or network protection/control systems have changed, as AEMO may not be aware in all cases.

4.4.3 AEMO's conclusion

AEMO will continue to consult broadly with all stakeholders interested in the subject matter of the SRAS Guideline. As identified in the draft SRAS Guideline, AEMO will consult with TNSPs in determining matters such as aggregate reliability and scheduling of testing.

As AEMO cannot rely solely on GPS data for SRAS modelling purposes, all prospective SRAS providers will be required to either provide new data or update previous information if relevant. Updates will be necessary where there have been changes to SRAS equipment or related generation plant since the date on which the last valid set of modelling data was provided to AEMO (in many cases during the 2014-15 SRAS procurement). Changes include new or upgraded plant, and new or amended protection and control systems.

4.5 Procurement Process

4.5.1 Issue summary and submissions

In the Issues Paper, AEMO discussed two alternative processes for procurement of SRAS, namely open competitive tender or direct request for offer. AEMO also identified the matters it would consider in determining which procurement process to use, and the steps involved in each process.

The four key issues raised in submissions relating to SRAS procurement were:

- Absence of an Expression of Interest (EOI) step.
- Ability to contract sources prior to SRAS providers meeting the SRAS requirements.
- Contract duration.
- Resolution of an identified shortfall in meeting the SRS.

Energy Australia submitted that any procurement process should be open to all stakeholders capable of supplying SRAS, with direct procurement considered as a last report option by AEMO.

AGL submitted that a direct procurement option is predicated on information provided more than two years ago and would need to appropriately account for new entrants into the SRAS market, as well as system upgrades (e.g. protection and control systems) completed since 2015. AGL considered a competitive process would provide for a least-cost SRAS solution over time. With a smaller SRS and new suppliers entering the market, there is potential for additional competition not previously present.

ERM considered that for the 2018 procurement process, AEMO should adopt a similar process to previous years, with an initial Expression of Interest (EOI) to assess potential SRAS sources, moving to a short list of participants from which formal SRAS offers would be sought.

Clarification was sought in consultation forums about the prospects of AEMO contracting prospective SRAS to incentivise the development of new sources, even though the SRAS equipment may not be in place. ERM's submission expressed concern that relatively short (three-year) SRAS contracts may act as a barrier to entry for potential new restart services, leaving AEMO reliant on 'ageing' plant, the maintenance and compliance costs of which will increase over time. ERM suggested that newer, more

flexible plant may provide a lower overall cost and a more technically optimal service. It proposed increasing contract duration to 8-10 years, allowing capital costs to be smoothed over a longer period and promoting new entry of more flexible lower cost providers.

ERM also submitted that where a shortfall has been identified and acknowledged by AEMO for an electrical sub-network, and AEMO rejects an unsolicited offer that complies with the SRAS Guideline for that sub-network, then AEMO should prepare a report for the Reliability Panel and the AER as to the reasons for a rejection of the unsolicited offer.

Hydro Tasmania sought advice on how AEMO would determine an appropriate procurement process option (competitive tender or selective negotiation), and the description of each process. This was also discussed at a number of consultation forums.

There was discussion at the Tasmanian forum on AEMO's procurement decision-making: how risks are ranked; what weighting is given to TNSP input; and who makes the final decision on procurement.

4.5.2 AEMO's assessment

Due to the extent of the data collected from generators and TNSPs and the extensive modelling performed by AEMO and its consultants in 2015, AEMO is confident that it has a comprehensive picture of the current suite of NEM generation that has, or reasonably could have, potential to provide SRAS across all of the regions. Given AEMO's role in connection of new generation or alteration of generating systems in a way that impacts performance relative to the GPS,[14] AEMO would expect to become aware of any additional new SRAS capable generation. However, any potential provider is also free to approach AEMO at any time, and AEMO would request the data necessary to assess its SRAS potential.

Competitive procurement will always be AEMO's preference where it is reasonably expected that competition will exist in a sub-network. With AEMO's current understanding of generation and network capability, an EOI stage is considered unnecessary before inviting competitive tenders, and its cost cannot reasonably be justified[15]. AEMO will assess this position should new potential SRAS sources emerge before commencement of a particular procurement process. Invitations to tender (ITTs) will be published on AEMO's website and all known generators with black start capability will be notified of the process.

With respect to the forthcoming procurement, by 1 July 2018 AEMO must take all reasonable steps to procure sufficient SRAS to meet the revised SRS at the least cost[16]. To do this, AEMO will need to have satisfied itself through an SRAS Test that the proposed SRAS equipment in each case can meet its stated capability at an established level of individual reliability. Generators that are not currently SRAS-ready are encouraged to explore whatever avenues they can to make themselves SRAS capable in time for AEMO to complete this process prior to contracting. Where AEMO has sufficient available and tested SRAS to meet the SRS as of 1 July 2018, AEMO is obliged to contract SRAS that can be provided as at that date. Contracting with speculative services over and above what is needed to meet the SRS would conflict with the SRAS Procurement Objective in the NER. AEMO can see only limited circumstances in which this might be feasible, for example where a conditional contract could be combined with a flexible option to terminate another contract early. Jurisdictions may wish to contemplate assistance or incentives to promote additional investment in SRAS capability.

The contract duration is not fixed under the regulatory framework, but needs to be balanced against the reality that the SRS will be revised periodically (and indeed should be reviewed by the Reliability Panel annually). AEMO will consider longer term contracts, but is also cognisant that multiple contracts of different terms could make it difficult to maintain the SRS consistently. AEMO considers that the default

[14] NER clause 5.3.9
[15] Therefore not meet the SRAS Procurement Objective
[16] As required by the SRAS Procurement Objective

position on contract duration will remain at three years with extension options as in the existing contracts, but AEMO is willing to consider offers for different terms in circumstances where that is assessed to deliver greater value to consumers as part of the overall procurement of SRAS in a sub-network.

With respect to a shortfall in meeting the SRS, AEMO's reporting obligations in that regard are set out in the NER, and are not within the scope of the SRAS Guideline.

With respect to decision-making during procurement, AEMO will consult with relevant TNSPs on appropriate aspects of its assessment of the combination of services in each sub-network capable of meeting the SRS. However, AEMO makes the final determination on SRAS procured. AEMO is also responsible for making the final determination of system restart plans. It does this after considering technical information from NSPs and generators, and also intends to consult with JSSCs.

4.5.3 AEMO's conclusion

AEMO proposes no substantive changes to the draft SRAS Guideline with respect to the Procurement process.

AEMO expects the default SRAS contract duration will be three years, with an AEMO option to extend by one year, and a further one year by mutual agreement. However, alternative contract terms may be offered, and AEMO will consider these by exception, where this is likely deliver greater value to consumers as part of the overall procurement of SRAS in a sub-network.

AEMO's Invitation to Tender (ITT) will identify the tender process steps and timelines, and the information to be submitted in or with a tender offer.

4.6 Determination of Electrical Sub-Networks

4.6.1 Issue summary and submissions

AEMO identified in the Issues Paper that it is conducting further studies to verify whether the existing electrical sub-networks (determined in 2014) will remain consistent with the revised SRS from 1 July 2018.

Submissions on the boundaries of electrical sub-networks included the following:

- Energy Australia considered the boundaries of electrical sub-networks should not be amended at this time, as that would require the Reliability Panel to review its recent SRS determination. This is likely to create additional costs and delays in the procurement of SRAS. Energy Australia suggested it would be more appropriate to review the sub-network boundaries only after implementation of the new SRS and supporting SRAS Guideline, and only then if it will help AEMO procure SRAS at lower costs.
- ERM Power suggested that, in determining the boundaries, AEMO modelling and the restart plan should not allow for the use of non-contracted SRAS sources, as absent ongoing maintenance and routine testing, historical SRAS sources may no longer be available for dispatch if required.
- ERM also suggested that due to the length and multiple network elements between electrical sub-networks and between a number of current SRAS sources and other generators within them, the current electrical sub-networks within the NEM are less than optimum from a system restart perspective. ERM suggested this would lead to higher economic loss and social disruption than would be the case if improvements in electrical sub-region boundaries were implemented.
- ERM submitted that assessments of electrical sub-networks should include:

- The potential for a ‘black swan’ event to occur where a major switching or terminal station has failed and all network elements terminating at the location are no longer available for use to complete the restart of the system. This would also simulate the loss of multiple transmission lines due to multiple tower failure.
- A maximum number of network elements required to be energised to move restart energy from the SRAS source to other generators within the electrical sub-network. As identified in the September 2016 SA system black event, each additional network element required to be energised increases the risk that the restart source will be unable to restart other generators when required to do so.[17]

- Hydro Tasmania noted the SRS requirement to consider the number and strength of transmission corridors connecting an area to the remainder of the power system, in determining sub-networks. Hydro Tasmania is concerned that the current assessment of only one sub-network in Tasmania does not sufficiently consider the risks associated with loss of the single transmission corridor between Northern and Southern Tasmania, noting the bushfire risks around this corridor. It suggested technical information from TasNetworks will assist AEMO to facilitate the procurement of adequate SRAS to enable a coordinated response to any major supply disruption in Tasmania.
- Origin was comfortable with the current electrical sub-networks as they appear in the draft SRAS Guideline, especially taking into account the special requirements for capacity north of Sydney.
- Snowy Hydro encouraged AEMO to critically assess whether it is more appropriate for NSW to have two electrical sub-networks instead of relying on the additional requirement for SRAS capable of restoring 500 MW of generation capacity north of Sydney.
- ENA considered it imperative for a common understanding of the meaning of "secure" in relation to the system restart process - referring to how AEMO interprets the new SRS requirements for maintaining a satisfactory, and then secure, operating state in a sub-network from a stage in the restoration when AEMO determines it practicable to do so.

4.6.2 AEMO’s assessment

AEMO is obliged by the NER to set electrical sub-network boundaries in accordance with the guidance specified in the SRS. Since that guidance has changed in the recent determination, AEMO must therefore consider whether the existing boundaries remain consistent with the SRS. The Reliability Panel decided not to provide explicitly in the SRS for interim arrangements should AEMO need to change the boundaries, but instead accepted that it would need to review the SRS in that event.

In response to ERM’s suggestions:

- AEMO's existing modelling, plans and procedures do not rely on non-contracted black start capability to initiate the restoration process. AEMO does not assume that any sources other than those procured through a SRAS contract will restart without first being energised via the network. However, every scheduled generator must have its own local black start procedures, which feed into the development of the restart plans.
- In 2015, AEMO reviewed the electrical sub networks, supported by a consultant, and found the likely "break points" across the NEM were at the interconnectors. All regions except Queensland were reduced to one electrical sub-network for this reason, with Queensland reducing from three to two. The Reliability Panel has determined the revised SRS with different standards for each of the existing electrical sub-networks. The standards require AEMO to

[17] AEMO has considered these submissions in its assessment of aggregate reliability (section 4.2.2)

procure SRAS with sufficient reliability to meet the target MW and timeframes. AEMO must also be able to restore supply in the sub-network while maintaining a satisfactory operating state to the extent practicable during the restoration process, and maintain a secure operating state from a stage in the restoration when it is practicable to do so, as determined by AEMO.

- The power system studies carried out for the 2015 SRAS procurement confirmed that these criteria can be met with the current boundaries of electrical sub-networks. Any proposed alternations to the boundaries of electrical sub-networks must be assessed against these criteria, and can only be approved subject to compliance with these criteria.
- AEMO has addressed ERM's comments regarding the failure of transmission elements in the discussion of aggregate reliability in section 4.2.2.

In relation to Tasmania, based on information currently available, AEMO considers that the current single sub-network is consistent with the revised guidance in the SRS. Subject to receipt of information on any additional studies that TasNetworks may have undertaken, AEMO considers that the power system can more readily be maintained in a satisfactory operating state and move to a secure operating state as a single sub-network. Irrespective of the boundaries and quantities of electrical sub-networks within a region, the need for quantity of SRAS sources is primarily determined by overall requirement on the restoration target (in MW) and timeframe, as well as the aggregate reliability for the electrical sub-networks.

AEMO will consider the concerns raised in relation to the vulnerability of the north-south transmission corridor as part of its aggregate reliability assessment.

With respect to the New South Wales electrical sub-network, again AEMO considers the current boundaries are consistent with the revised SRS. AEMO currently has no information to justify re-evaluation. In particular, AEMO is not aware of any material changes to the technical characteristics of the network that would affect AEMO's ability to achieve its power system security responsibility relating to SRAS. If AEMO receives relevant information from TransGrid indicating otherwise, AEMO will assess this prior to making its final determination. It is worth noting that the separation of New South Wales into two electrical sub-networks would impact the number of SRAS sources likely to be required in the region to meet the revised SRS.

AEMO understands that the concept of a secure operating state is well understood by NSPs, generators and other registered participants. In the context of determining electrical sub-network boundaries, AEMO must be satisfied that the supply can be restored in that area as an island, and that the restoration can proceed while maintaining that island in at least a satisfactory state, moving to a secure (N-1) operating state as soon as practicable as the restoration proceeds.

4.6.3 AEMO's conclusion

AEMO's draft determination is that the boundaries of electrical sub-networks will remain unchanged.

4.7 Other SRAS-Related Issues

4.7.1 Issue summary and submissions

Customer Load restoration

Hydro Tasmania submitted that not only must the SRAS objective be met, but in this process consideration is also given to the ultimate objective of supplying customer load. Hydro Tasmania anticipates that the JSSC would be consulted during this process.

TasNetworks also stated during forums that consultation on the SRAS Guideline should extend to consideration of load restoration and that there are limitations in selecting a resource based on the procurement standard only.

4.7.2 AEMO's assessment

The scope of the SRS does not include the restoration of load. However, the Reliability Panel considered economic assessments of the cost of load not being supplied when setting the SRS for the procurement of SRAS to restore generation and transmission. In undertaking SRAS procurement, AEMO must of course consider single points of failure that could prevent it from meeting the revised SRS, and is aware of its power system security responsibility under NER 4.3.1(p).

In relation to load restoration, AEMO plans for that process in developing the regional system restart procedures. AEMO currently works most closely with TNSPs in that process, and will invite JSSCs to become more involved. AEMO's proposed rule change regarding confidentiality of system restart plans may facilitate greater involvement.

4.7.3 AEMO's conclusion

No change to the SRAS Guideline is proposed with respect to load restoration, as this is beyond its scope.

4.8 NSCAS Tender Guidelines

4.8.1 Issue summary and submissions

The NER requirements for AEMO to make guidelines on the procurement of SRAS were changed in July 2015 and moved to a new clause in the NER. They were previously expressed as tender guideline requirements for non-market ancillary services (NMAS, comprising both SRAS and NSCAS) in clause 3.11.5 of the NER.

The previous tender guideline requirements remain in clause 3.11.5, but now apply only to NSCAS. Other than the change of reference from NMAS[18] to NSCAS, these requirements remain unchanged.

AEMO's practice for some years has been to publish its Tender Guidelines for SRAS and NSCAS in separate documents in any event. In the Issues Paper, AEMO therefore proposed to re-issue the NSCAS Tender Guidelines with substantially the same content, updated as necessary to reflect the current NER. AEMO expected any changes to the NSCAS Tender Guidelines (last determined in December 2011) to be minimal, and a draft was not been provided with the Issues Paper. Stakeholders were invited to comment on whether they considered that substantive changes to the NSCAS Tender Guidelines were necessary.

No submissions commented on the NSCAS Tender Guidelines.

4.8.2 AEMO's assessment

Having reviewed the 2011 NSCAS Tender Guidelines, AEMO notes that several of the requirements to be included in them, as set out in clause 3.11.5(b), were at that time addressed in the forms of request for EOI and ITT for NSCAS. These forms were published as attachments to the NSCAS Tender Guidelines. The forms included provisions relevant to the following requirements in clause 3.11.5(b):

- Testing of the NSCAS facility – subparagraph (2).
- Data, models and parameters to be provided – subparagraph (5).
- Terms and conditions of the ancillary services agreement that a successful tenderer would be expected to enter into – subparagraph (6).
- Principles AEMO will apply in assessing EOIs and tenders – subparagraph (7).

[18] Non-Market Ancillary Services

As EOI and ITT forms may be updated from time to time in the normal course of business, AEMO now proposes to address these requirements in the guidelines document itself, while providing some flexibility to adapt them to meet the circumstances of an individual NSCAS procurement where necessary. The relevant elements have therefore been added to the draft NSCAS Tender Guidelines, substantially as they appear in the December 2011 forms of request for EOI and ITT.

The NSCAS Tender Guidelines also included an indication that AEMO would seek to enter into NSCAS agreements for a term of two years with an early termination option if the NSCAS need were to be met in a different way. The NER do not require the guidelines to include this requirement. Although AEMO considers this may still be useful information for participants, it is necessary to reflect the likelihood that each circumstance is likely to be different, and will vary depending on AEMO's assessment of the particular NSCAS gap, and any proposals by the TNSP to fill it.

4.8.3 AEMO's conclusion

AEMO's draft NSCAS Tender Guidelines will be amended as follows:

- As necessary, to update to AEMO's latest template and reflect amendments in the terminology used in the NER (from NMAS to NSCAS).
- To include provisions taken substantially from the forms of EOI and ITT that were attached to the guidelines at that time.
- To provide for flexibility in the term of the agreement AEMO will seek.
- The terms and conditions of the sample NSCAS Agreement will continue to be published with the NSCAS Tender Guidelines.

5. DRAFT DETERMINATION

Having considered the matters raised in submissions and at meetings/forums, AEMO's draft determination is to make the SRAS Guideline in the form published with this Draft Report, in accordance with clauses 11.81.3 and 3.11.7 of the NER.

AEMO's draft determination of electrical sub-network boundaries is set out in clause 7 of the draft SRAS Guideline. These are unchanged from the existing electrical sub-networks, determined in September 2014.

AEMO has made a draft determination of the NSCAS Tender Guidelines in the form published with this Draft Report, together with a form of ancillary service agreement for NSCAS.

APPENDIX A - GLOSSARY

Term or acronym	Meaning
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator Limited
DNSP	Distribution Network Service Provider
EOI	Expression of Interest
GPS	Generator performance standards (under chapter 5 of the NER, in particular schedule 5.2)
ITT	Invitation to Tender
JSSC	Jurisdictional System Security Coordinator
MW	Megawatts
NEM	National Electricity Market
NER	National Electricity Rules
NSCAS	Network support and control ancillary service
NSCAS Tender Guidelines	The guidelines to be developed and published by AEMO under clause 3.11.5(b) of the NER.
NSP	Network Service Provider (distribution or transmission)
RP or Reliability Panel	The Reliability Panel established by the AEMC in accordance with rule 8.8 of the NER
SRAS	System restart ancillary service
SRAS Guideline	The guideline to be developed and published by AEMO under clause 3.11.7(c) of the NER.
SRAS Procurement Objective	The objective AEMO is to achieve by procuring SRAS, as set out in clause 3.11.7(a1) of the NER.
SRAS Provider	A Registered Participant who provides SRAS, or has offered to provide SRAS, to AEMO.
SRS	System restart standard (unless otherwise specified this refers to the version determined by the Reliability Panel and published by the AEMC on 15 December 2016, effective from 1 July 2018).
TNSP	Transmission Network Service Provider

APPENDIX B - SUMMARY OF SUBMISSIONS AND AEMO RESPONSES

The following table summarises the issues raised in written submissions to the first stage of consultation and AEMO's responses.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
AGL Energy Ltd (AGL)	**General Support**	AGL supports the majority of AEMO's proposals put forward in the issues paper.	Noted
	SRAS 24 hrs Test	24 hrs notice may not provide enough time for the SRAS provider to ensure their operational position is protected while they are testing the SRAS unit. AGL proposes that the SRAS guidelines adopt a mechanism whereby the SRAS operator has a right of reply. This reflects that there some instances where a delay in testing would be justified. AGL also considers the additional performance certainty achieved by a second test comes with a cost. Tripping off a unit from a full load is a very strenuous test that will place an extra burden on every component in the system.	AEMO acknowledged in its issues paper the need to minimise the system and market impact of testing and will implement a number of measures to provide some assurance for SRAS providers, including restrictions on timing and prior liaison between AEMO and the TNSP. AEMO's revised proposal is that there will be up to 2 tests (1) the first nominated by AEMO with a notice period to the generator of not less than 5 business days; (2) a test after any significant maintenance involving the SRAS equipment. AEMO is aware of the potential impacts from a business point of view, and notes these will vary depending on timing in relation to market conditions in particular. AEMO will seek further feedback on the revised proposal with the aim of confirming a regime that balances the need for realistic testing with reasonable business interests.
Energy Australia Pty Ltd (EA)	**General Support**	EA notes the SRAS Guideline is critical to ensuring the SRS is met, meaning the grid can be re-energised in an efficient timeframe at lowest cost. The goal of efficiently restoring a secure and reliable system has to be balanced against the potentially significant costs of procuring such services as the costs are ultimately paid for by end-use consumers. EA recognises the revision of the SRS creates both opportunities (e.g. smaller targets and timeframes) and challenges for AEMO (e.g. balancing the factors contributing to aggregate reliability).	Noted and agreed.
	SRAS 24 hrs Test	EA understands AEMO is attempting to replicate a real world scenario and in principle agrees with AEMO's proposed approach, but considers there is a need for discretion in implementation. Any 'spot tests should not be scheduled during peak periods in order to minimise the market impacts of these tests, in addition to any potential commercial implications for an SRAS provider. Any form of testing will have implications for TNSPs and generators alike: TNSPs will need to ensure no constraints or maintenance is occurring. SRAS providers are required to have their station manned appropriately in order to back their offers, but the timing of tests can have a number of commercial implications, e.g. in peak periods.	Noted. Refer to AEMO response to AGL's comments on this issue

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	Procurement Process	EA acknowledges AEMO's efforts in completing extensive power system studies in the 2015 procurement process. Despite this EA considers that AEMO's proposals for direct procurement is predicated on information provided more than two years ago and would need to appropriately account for new entrants into the SRAS market, as well as system upgrades (e.g. protection and control systems) completed since 2015. A competitive process will provide for a least cost SRAS solution over time. With a smaller SRS and new suppliers entering the market, there is potential for additional competition not previously present. Any procurement process completed by AEMO should therefore be open to all stakeholders capable of supplying SRAS with direct procurement considered as a last report option by AEMO.	As a result of the previous studies AEMO currently has a very good idea of the NEM generation that has, or could have, potential to provide SRAS, Given AEMO's role in the connection of new generation and the requirement for registered participants to inform AEMO about any significant changes to their plant, AEMO would expect to become aware of any additional new SRAS capable generation or changes to existing capability. However any other potential entrant is also free to approach AEMO at any time. If any such provider were interested in entering the SRAS market AEMO would request the data necessary to assess its SRAS potential. Competitive procurement will always be AEMO's preference where it is reasonably expected that competition will exist in a sub-network. However, in most cases an EOI stage is unlikely to be necessary before inviting tenders. AEMO will assess the position before commencing procurement. ITTs will be published on AEMO's website.
	Aggregate Reliability	EA considers the SRS aggregate reliability measure should provide greater flexibility to AEMO's approach to procuring SRAS, noting AEMO will consider individual reliability as part of the broader aggregate reliability assessment and not impose minimum availability or reliability thresholds on individual generators. However, depending on location and operation of individual generators, it is possible only one SRAS provider is available at the time the service is required. It may therefore be more prudent to consider/set minimum availability or reliability thresholds for individuals as part of the procurement process.	AEMO agrees with EA's assessment. While AEMO does not include to exclude technically capable black start facilities from offering to provide a service based on their individual reliability alone, clearly higher reliability will be assessed as having greater value - to be assessed against cost and other SRS considerations between all other options offered for a sub-network. However, if selected and contracted, an SRAS provider's contract will specify a minimum availability/reliability requirement that must be met for the duration of the contract, based on the offer made by the provider and AEMO's assessment of it. This is critical because AEMO will have assessed the aggregate reliability of all the procured SRAS based on individual reliability. Any reduction in individual reliability levels in the contract period can result in a failure to meet the SRS.
	Determination of electrical sub-networks	EA considers the boundaries of electrical sub-networks should not be amended at this time, as that would require the Reliability Panel to review its recent SRS determination. This is likely to create additional costs and delays in the procurement of SRAS. It would be more appropriate to review the electrical sub-network boundaries only after implementation of the new SRS and supporting SRAS guideline, and only if it will assist AEMO with procuring SRAS at lower costs.	Noted, and this is an issue that AEMO brought to the attention of the Reliability Panel in deciding to set different standards by electrical sub-network. AEMO is obliged by the NER to set boundaries in accordance with the guidance specified in the SRS. Since that guidance has changed in the recent determination, AEMO therefore needs to consider whether the existing boundaries remain consistent with the SRS. The Reliability Panel decided not to provide explicitly in the SRS for interim arrangements should AEMO need to change the boundaries, but instead accepted that it would need to review the SRS in that event.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
Energy Networks Australia (ENA)	**SRAS Individual Reliability**	ENA is supportive of the need for AEMO to take into account the state of the transmission network in undertaking SRAS assessments, but notes that determining whether or not transmission infrastructure is intact or feeders are effective and operational can be quite problematic in the sort of conditions (e.g. bushfires, cyclones/tornadoes) that can initiate 'system black' events. ENA would welcome a clear elucidation of the weighting process of potential SRAS providers, and also considers it important for AEMO to clearly state the number of units a potential SRAS Provider must have available (inclusive of maintenance requirements) to be a valid SRAS supplier candidate.	Individual reliability (IR) is a component of aggregate reliability (AR). The AEMC Reliability Panel (RP) final determination (p68) defined the reliability of any individual restart service (IR) to incorporate the expected start up performance and availability of that service as well as the reliability of the transmission components between the restart service and the first transmission substation which it is connected. In assessing an individual service, AEMO will not make any assumptions about the condition of those transmission components as a result of any event that may have led to a black system. The SRS does not require this and it would be impossible to do. Instead, we will be seeking assistance from TNSPs to perform an engineering assessment on the reliability of the transmission elements up to the first substation. That may take account of a range of matters including historical performance, technical characteristics, age or redundancy of components.
	Aggregate Reliability (Measure)	ENA understands there are common concerns as to the detail, form and potential formulaic representation of the aggregate reliability measure. TNSPs will need to develop and provide reliability data for a black start context, and therefore need to understand the likely black start sources and relevant parts of their networks. AEMO and TNSPs should jointly develop the approach used to determine aggregate reliability, and ENA looks forward to providing more comments as AEMO develops its interpretation of and approach to this important measure.	AEMO is keen to engage TNSPs as part of the development of the appropriate measures and values this input upfront. We would prefer the reliability measures to be developed with TNSP assistance, not by AEMO providing a detailed approach for comment, as this would be inefficient. As far as practical, reliability assessments should be conducted as a whole of network exercise, so that AEMO and TNSPs are able to identify which parts of the network are more susceptible than others in assessing the value of potential SRAS sources located at different points to restore supply across the sub-network. This seems preferable to performing assessments targeting only the restart paths of sources that are currently considered likely.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	Aggregate Reliability (Strategic Location and Diversity)	a. The Reliability Panel has recognised the need to take account the risk of transmission network damage when assessing potential SRAS sources and/or the failure of any single significant transmission element, such as a single line or corridor downstream of the first transmission substation in the restoration path. ENA also emphasises the geographical diversity criterion. b. ENA concludes that AEMO must therefore include the ability to restore significant customer load from the SRAS source(s) and not confine the application of clauses 8 and 9 to the electrical diversity of restart sources only. For example, ENA says it is insufficient for AEMO to procure SRAS sources in a generation-rich area with the ability to meet the standard, if that generation cannot facilitate power system restoration because of a vulnerable transmission corridor connecting to load. c. ENA also requests AEMO confirm Energy Network Australia's current understanding that aggregate reliability will take into account both credible and non-credible events.	a. The risk of transmission damage is manifested in the SRS through the electrical (and to some extent the geographical) diversity criteria, in other words the need to assess single points of failure, including the failure of single transmission elements. The electrical diversity criteria expressly represent the Reliability Panel's guidance as to how to take account of potential network damage. There is no separate or incremental requirement for AEMO to consider network damage, and indeed the Reliability Panel recognised the impracticality of such a requirement. b. The scope of the SRS does not include the restoration of load, but in procuring SRAS to restore sufficient generation and transmission to supply the specified MW in the SRS, AEMO must of course consider single points of failure that could prevent it from meeting the SRS and AEMO's power system security responsibility under NER 4.3.1(p). AEMO understands the example to refer to the Tasmanian network, and will discuss specific concerns with TNSPs individually in developing the network reliability assessments. c. The failure of any single major transmission element is always considered as a credible contingency, irrespective of the cause. AEMO considers this is consistent with the electrical diversity criteria in the SRS. It is not considered that AEMO should account more than one contingency i.e. N-2 or beyond.
	Determination of electrical sub-networks	ENA considers it imperative for a common understanding of the meaning of "secure" in relation to the system restart process - referring to how AEMO interprets the new SRS requirements for the maintenance of a satisfactory, and then secure, operating state in a sub-network from a stage in the restoration when AEMO determines it practicable to do so.	Noted. AEMO considers that the concept of a secure operating state is well understood by NSPs, generators and other registered participants. In the context of determining electrical sub-network boundaries, AEMO must be satisfied that the supply can be restored in that area as an island, and that the restoration can proceed while maintaining that island in at least a satisfactory state, moving to a secure (N-1) state when practicable as the restoration proceeds.
	Modelling and Assessment	a. ENA will work with AEMO to provide additional data and information to undertake the modelling of alternate re-energisation paths given due consideration to both the timing and cost-effectiveness to do so. It is understood that such alternative paths would be at the initiation of the relevant TNSP involved. b. ENA notes that AEMO intends to collect data and undertake modelling as part of its SRAS assessment processes. Subject to commercial confidentiality, it would be beneficial if AEMO could share the models and restart studies with TNSPs. This would be consistent with the policy intent of AEMO's own Generating System Model Guidelines rule change proposal and AEMO's impending rule change proposal on sharing more SRAS information with key participants. This approach will provide useful insights in developing regional system restart plans.	a. Noted b. Noted.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	SRAS 24 hrs Test	a. ENA supports the need for appropriate testing of SRAS, but notes careful consideration and co-ordination of technical testing arrangements is essential. There appears to be stakeholder consensus that AEMO and TNSPs need to liaise closely to ensure the scheduling window options for such tests have minimal market impacts and participant costs. b. Short notice testing can create both costs and risks for TNSPs, customers and generators and it is not clear in the current draft how AEMO intends to address these, e.g. by measures such as direct payments or indemnities. Appropriate consideration will need to be given as to what arrangements and cost recovery mechanisms will need to be put in place to conduct additional testing. ENA considers it appropriate that the AER provide 'in principle' support indicating that TNSP participation in tests will be immune from financial penalties associated with the STPIS, or TNSPs are appropriately indemnified	a. The need for coordination on testing is acknowledged, refer to previous responses. b. Rules around negotiation of testing arrangements between NSPs and prospective SRAS providers are in NER 3.11.9(i). AEMO will not provide indemnities or direct payments to TNSPs. AEMO is however happy to participate in any discussions with the AER to confirm the scope of the applicable STPIS components.
	Other Issues	a. New Technologies: ENA supports the role that new technologies (other than synchronous generation) can play in providing ancillary services and that the rules and SRAS guidelines have to be flexible to accommodate these new technologies. b. Mandatory Reporting of procured SRAS: There may be value in requiring that mandatory reporting be implemented for contracted SRAS generators in relation to any failures to start, non-conformances or any trips that occur, with AEMO. c. Need to address sensitive loads: The Reliability Panel considered at page 84 of its Final Report that “In the event that an individual customer or customers require an increased level of protection from major supply disruptions over and above that provided to them under the Standard, the Rules allow them to negotiate an energy support arrangement [ESA]. This would be a contract arrangement between the customer or the associated jurisdiction and either a generator or network business”. ENA states AEMO and TNSPs will need to develop arrangements regarding the linking of ESAs and SRAS, including management and priority of a support generator in the restoration process.	a. AEMO also supports broadening the range of technologies that can provide SRAS where they become available. However it notes that currently the NER define black start capability as something that is provided by generating plant. b. Noted. Some reporting is already covered in the contract arrangements, but AEMO will further consider whether additional requirements are warranted given that the individual reliability assessment will include additional parameters. c. Noted. AEMO agrees that any ESAs entered into by customers for additional system restart support will need to be well understood, consistent with, and accommodated within the regional system restart procedures.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
ERM Power Ltd (ERM)	**State of Transmission System**	Events in SA question the logic that assumes the transmission network remains intact to facilitate the activation of SRAS if it is required. ERM considers this needs to be reconsidered and AEMO's restart model amended to cater for low probability 'black swan' type events where sections of the transmission network may not remain intact. ERM remains concerned that the restart model is based on theoretical assumptions regarding the restoration of generation; and should be amended to allow for inclusion of observable historical outcomes. ERM is of the view that the restart plan is premised on all components achieving close to perfect outcomes and this may result in a false sense of security with regard to the timeliness of achieving a successful restart being promoted to jurisdictions and consumers.	AEMO is obliged to procure SRAS capable of meeting the SRS at the least cost. The revised SRS incorporates additional reliability parameters which AEMO will incorporate, accounting for single points of failure and individual source performance. The Reliability Panel final determination stated very clearly that AEMO cannot be required to assess all possible combinations of network damage that could arise, but the possibility of network damage is appropriately accounted for in the electrical diversity criteria. As was evident from the SA experience, historical performance is not necessarily any guide to performance on the day. In terms of timing restoration timing, the SRS is expressly a procurement standard only. AEMO has and will continue to emphasise that where necessary, and this is recognised in the NER and in the Reliability Panel's final determination. In a black system situation AEMO and all registered participants will do everything that can be done to restore supply as quickly as possible, which is what happened on 28 September notwithstanding that the contracted SRAS sources were not available for different reasons. That is why the restart plans include alternative paths.
	SRAS 24 hrs Test	ERM supports AEMO's proposal to conduct an additional short notice (within 24 hours) test of contracted SRAS source. ERM notes the logistical issues but does not believe they are insurmountable. The major issue associated with this short notice test is the recovery of the service provider's costs, including market costs incurred in conducting the test. ERM proposes the SRAS contract include separate cost recovery for the planned and short notice tests, with a formula referencing the regional reference price to recover the market costs component. ERM supports the proposal for end to end testing under simulated system black conditions, from loading representative of expected load at peak system demand. Following resynchronisation, the steps for loading should be specified by AEMO in real time to simulate the random variation in loading that represents most likely outcomes during restoration. This may include unexpected decreases in loading.	Noted, AEMO has considered these suggestions.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	SRAS Individual Reliability	The sizing and capability of any initial energy source that is used to restart a large unit must be taken into consideration. This should include an assessment of energy requirements to ensure security of other units at a multi-unit power station as well as the energy requirements for the SRAS unit and the level of redundancy contained in this initial energy source. The number of physical generating units offered as available as an SRAS source is particularly important with TTHL given the historically low success rate of TTHL sources during system black events. The assessment of reliability should also include a historical assessment of unit return to service performance, a timely resynchronisation factor, which could be calculated based on data where a unit has come out of service for any reason and been resynchronised within 24 hrs. In assessing network connection and flow paths, ERM considers a unit connected via a single circuit breaker and single network connection to one other generator would have less redundancy, and therefore lower reliability than a generator connected by a double bus double breaker or breaker and a half connection arrangement and multiple network flow paths to multiple generators. In assessing the network availability, the calculation should include both in-service trips, time out of service and failed attempts to energise any network component in the flow path. ERM offered a suggested formula and worked example for individual reliability calculation taking into account all of these factors.	Noted, and AEMO is considering all these concepts. AEMO is proposing to assess, as part of individual reliability, - a redundancy factor that represent points of failure / single component dependencies within SRAS equipment - an operational reliability factor that might include other factors affecting reliability e.g. back-up fuel supplies. The number of generating units available to act as a TTHL source will of course be accounted for as part of the redundancy component. However, it is unclear what ERM is referring to in relation to historical success rates. To clarify, the individual reliability assessment considers network component reliability up to the first substation. Network reliability (including single points of failure) beyond that point are considered as part of AEMO's assessment of aggregate reliability of the SRAS sources for a sub-network. The availability of units needs to be appropriately reported and monitored, to ensure that declared availability is true and fair reflection of actual SRAS equipment availability.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	Aggregate Reliability (Diversity and calculation)	SRAS sources should be provided from diverse geographical locations, a diverse set of source types and allow for diversity in energy fuel source: - Diversity of geographical location should ensure that each SRAS source has an individual and discrete network flow path to other generators. - Diversity of SRAS source type should ensure a mixture of different types of SRAS sources are available to provide restart energy to the electrical sub-region. We do not believe it is prudent to procure all or the majority of restart sources based on one type of restart source, e.g. all restart sources for an electrical sub-region are trip-to-house. - Diversity of fuel source should ensure multiple sources are not dependent on a single fuel source, e.g. a single gas pipeline. Given the uncertainty that gas will be available for use in the event of a system black event, a restart source capable of gas or liquid fuel operation would be preferable to a gas-only source. In calculating aggregate reliability, AEMO needs to allow for the probability that multiple SRAS sources may fail simultaneously, whilst the probability of this is very low, nevertheless, the potential for this to occur exists and should be factored into the calculation. Currently, AEMO has yet to offer any proposed calculation for the calculation of aggregate reliability for review and comment. We look forward to AEMO providing their proposed calculation during the second stage of this consultation.	AEMO will seek to procure diverse sources consistent with these factors, as described in the SRS, where they are offered (for example no fuel source diversity is available in Tasmania). Diversity is part of the aggregate reliability requirements, and each aspect will involve different considerations. This will depend in part on the specific arrangements in place for individual sources and conditions affecting them both individually and in common with others. The SRS sets the guidance that AEMO will follow in assessing the aggregate reliability (AR), incorporating the individual source reliability (combining availability, start up performance and transmission component reliability up to the delivery point), and (2) electrical, geographical and energy source diversity, accounting for single points of failure across the SRAS procured for the sub-network - for example aggregate reliability of two sources will be lower if they share the same single transmission corridor than it would if they had different paths. AEMO does not intend to deliberately procure SRS to achieve a greater degree of redundancy of sources than the SRS requires. To do so would be contrary to the NER. AEMO will be seeking assistance from TNSPs to perform an engineering assessment on transmission reliability. As part of this consultation AEMO has called for submissions on the way in which this assessment should be performed. This is the most challenging aspect of implementing the SRS, and AEMO does not believe it can be reduced to a formula or even a series of formulas.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	Determination of electrical sub-networks	a. ERM Power suggests that AEMO include the potential for a 'black swan' event to occur where a major switching or terminal station has failed and all network elements terminating at the location are no longer available for use to complete the restart of the system. This would also simulate the loss of multiple transmission lines due to multiple tower failure. b. AEMO should consider a maximum number of network elements required to be energised to move restart energy from the SRAS source to other generators within the electrical sub-network. As identified in the September 2016 SA system black event, each additional network element required to be energised increases the risk that the restart source will be unable to restart other generators when required to do so. c. In determining the boundaries, AEMO modelling and restart plan should not allow for the use of non-contracted SRAS sources, as absent ongoing maintenance and routine testing these historical SRAS sources, as demonstrated during the SA restart process, may no longer be available for dispatch if required. d. ERM Power is concerned that due to the length and multiple network elements between electrical sub-regions and between a number of current SRAS sources and other generators within these electrical sub-regions the current electrical sub-regions within the NEM are less than optimum from a system restart perspective and this will lead to higher economic loss and social disruption than would otherwise be the case if improvements in electrical sub-region boundaries were implemented.	a. In terms of procurement, the SRS reliability assessment must take into account the possibility of a single major transmission element failure. In operational terms (i.e. planning restart paths), these matters are discussed and managed at the regional SRWG level where there are AEMO, TNSP. DNSP and now regional JSSC will be represented. The system restart plans/procedures consider and provide for alternate restart paths where feasible. As recognised in the final determination AEMO clearly cannot and will not procure SRAS to cover every permutation/combination that may cause a black system. b. It is unlikely AEMO will impose any maximum requirement for the number of network elements, due to the need to maximise the number of potential SRAS sources. However AEMO recognises that a larger number of potential points of failure will reduce the value of an SRAS source in terms of its reliability. AEMO considers this to be part of the SRS diversity requirement. c. AEMO's existing modelling, plans and procedures do not rely on non-contracted black start capability to initiate the restoration process. We do not assume that any other source will restart without first being energised via the network. However, every scheduled generator must have its own local black start procedures, which feed into the development of the restart plans. It is unclear what ERM is referring to in relation to the system black event. d. In 2015 AEMO reviewed the electrical sub networks, supported by a consultant, and found the likely "break points" across the NEM were at the interconnectors. All regions except Queensland were reduced to one electrical sub-network for this reason, with Queensland reducing from 3 to 2. The Reliability Panel has determined the revised SRS with different standards for each of the existing sub-networks, which require AEMO to procure SRAS with sufficient reliability to meet the target MW and timeframes, and to be able to restore supply in the sub-network while maintaining the entire area in a satisfactory, and if possible secure, operating state. Note, if AEMO decides to revise the boundaries, the Reliability Panel will need to review the SRS.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	Procurement Process	a. ERM is concerned that the majority of existing restart sources are based on plant that is ageing and over time most of them will retire from the NEM. As the plant ages the cost to maintain equipment and comply with the proposed testing regime will increase resulting in increased SRAS procurement cost to consumers. Newer more flexible plant may provide a lower overall cost and a more technically optimal service. The historically short length of SRAS contracts has acted as a barrier to entry for new restart services which need to recover their capital costs. Increasing the contract length to 8-10 years allows the capital cost to be smoothed over a longer period and promote new entry of more flexible lower cost providers. b. For the 2018 procurement process ERM believes AEMO should adopt a similar process to previous years, with an expression of interest (EOI) for the offer of potential SRAS sources. AEMO should then prepare a short list of participants from which formal SRAS offers would be sought. c. ERM supports the proposal for a participant to provide an EOI or offer to provide SRAS to AEMO at any time. Where a shortfall has been identified and acknowledged by AEMO for an electrical sub-network, and an offer is made that complies with the SRAS Guidelines for that sub-network, then from a good governance perspective AEMO should prepare a report for the Reliability Panel and the AER as to the reasons for a rejection of the unsolicited offer.	a. Contract duration is not fixed under the regulatory framework, but needs to be balanced against the reality that the SRS will be revised periodically (and indeed should be reviewed by the RP annually). AEMO will consider longer term contracts, but is also cognisant that multiple contracts of different terms could make it difficult to maintain the SRS consistently. b. AEMO does not consider there is a need for an EOI stage in the 2018 procurement process, due to the extensive process done in 2015 to model generator and network capabilities. AEMO will request known SRAS-capable facilities and TNSPs to update AEMO on any material changes to protection and control systems if they have not already done so. Any potential new providers would be asked to provide similar information as soon as AEMO becomes aware of that capability. c. AEMO's reporting obligations in respect of a shortfall are set out in the NER, and not within the scope of the SRAS Guideline.
Hydro-Electric Corporation (Hydro Tasmania)	**Availability of information**	There are several significant issues requiring further information in the draft Guidelines. This information is required before a fully informed response can be formulated by participants, and sufficient time must be allowed for participants to review AEMO's further information prior to responding. In particular Hydro Tasmania requested that AEMO make available the formula or methodology AEMO intends to use to calculate aggregate reliability, an assessment of impacts of SRAS testing at 24 hours' notice, and how the technical data will be used in the individual reliability calculations.	This consultation covers a number of aspects on which AEMO is seeking specific input and proposals from impacted participants. The issues highlighted by Hydro Tasmania are good examples of these. AEMO needs this input in order to formulate a proposal that takes into account relevant matters on which AEMO may not yet have full visibility. AEMO's current assessment is that the aggregate reliability assessment cannot be reduced to a formula or a fixed methodology.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	Aggregate Reliability (Number, Location, Diversity)	Hydro Tasmania noted its key concern of only one SRAS currently procured in Tasmania, particularly given that Tasmania cannot rely on assistance from any other region during a system restart event. a. Hydro Tasmania requests transparency of AEMO's method for calculating aggregate reliability, in particular how AEMO will treat possible points of failure (particularly pertinent in Tasmania considering the possible single points of failure between the State's major load centres) and how the SRS diversity factors are weighted or assessed. . b. AEMO should utilise all the inputs provided by the TNSPs in its aggregate reliability considerations, and outline to the broader market the principles it applies in determining the aggregate reliability. c. The Reliability Panel noted during the SRS consultation that electrical diversity and the failure of any single significant transmission element (line or corridor) must be taken into account when assessing the number of services required. The currently contracted SRAS in Tasmania sits behind two separate (Farrell and Sheffield) substations and more significantly the connecting Sheffield-Farrell 220kV transmission lines. This transmission corridor runs through remote and rugged terrain and constitutes a significant single network point of failure risk. Any risk would be compounded if there was only a single corridor between the contracted SRAS station and the respective substation. Potentially this risk may imply either the breakpoint of a sub-network or the requirement for an alternative SRAS. d. If TasNetworks or Hydro Tasmania has no clear direction where to maintain, test and train for black system events then system restarts will be much less coordinated at a time when staff and processes will already be under considerable pressure.	a. It is highly improbable that a formula or detailed weighting methodology can be prescribed to represent all elements of aggregate reliability on a basis that could be consistently applied across all SRAS sources. These are not matters on which AEMO holds all the information, and AEMO welcomes constructive suggestions on the development of this assessment, as part of the current consultations on the SRAS Guideline. b. AEMO's clear preference is to work closely with the TNSPs to ascertain network reliability. c. The RP's final determination is that the assessment of electrical diversity is to account for any single points of electrical or physical failure across the procured SRAS sources for a sub-network. That is, single points of failure are part of the diversity assessment, not an additional consideration. d. It should be very clear what a contracted SRAS provider needs to maintain, and the responsibilities and expectations of NSPs and other generators will be set out in local black system procedures and the regional restart plans.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	SRAS 24 hrs Test	a. Hydro Tasmania notes that additional testing would be in line with Finkel Report recommendations, but testing with only 24 hours' notice is onerous on the SRAS provider and in particular the TNSP. b. Configuring the network for the testing and arranging isolations at such short notice could be detrimental to system security. AEMO should consider a one week notice period to undertake such a test. It should be acknowledged that participants have many competing demands on a day to day basis whereas in a real system black event the initiation of SRAS would have ultimate priority and attention. c. Consultation in advance by AEMO with the relevant TNSP is necessary. The SRAS provider is contractually liable to undertake the test but may be relying on the TNSP's switching. If the TNSP cannot facilitate the testing at short notice then the SRAS provider should not be penalised. d. The draft Guideline does not define how AEMO will consider market and power system conditions, and what market impacts AEMO will consider, including the SRAS provider's commercial interests. The risk of any unknown or unforeseen testing costs would need to be factored into the contract test charges.	a. and c. Noted and agreed. AEMO intends to confer with TNSPs to establish appropriate test times. See response to AGL comment for AEMO's proposed approach to testing. b. System security is AEMO's primary responsibility. AEMO will in conjunction with TNSPs ensure that preparation for SRAS testing can occur without jeopardising system security. AEMO acknowledges there is a need for more than 24 hours' notice to allow avoidable costs to be minimised and appropriate staffing levels to be organised. However AEMO's key objective is to verify that SRAS equipment, procedures and training is constantly maintained at a level necessary to maximise the chances of responding correctly to a disruption that can occur at any time. As such, testing is a vital system security measure and cannot be regarded as something to be done at the provider's convenience. d. AEMO will indicate in the Guideline the matters it will take into account in scheduling tests, recognising that to achieve the intended objective of SRAS providers being 'always ready', these cannot be too restrictive.
	Determination of electrical sub-networks	Hydro Tasmania draws attention to the SRS requirement to consider the number and strength of transmission corridors connecting an area to the remainder of the power system, in determining sub-networks. There is concern that the current assessment of only one sub-network in Tasmania does not sufficiently consider the risks associated with loss of the single transmission corridor between Northern and Southern Tasmania, noting the bushfire risks around this corridor. In this assessment, technical information from TasNetworks will assist AEMO to facilitate the procurement of adequate SRAS to enable a coordinated response to any major supply disruption in Tasmania.	Noted. AEMO has considered whether the number of electrical sub-networks in Tasmania should be revised based on the SRS guidance, and has concluded that the current determination meets the SRS requirements. Any additional studies provided by TasNetworks will be considered.
	Procurement Process	How AEMO proposes to determine an appropriate procurement process option (competitive tender or selective negotiation), and the description of each process. With regards to item 5.2, 5.3 and 5.4 of the draft SRAS Guideline (how AEMO determines a procurement process), it is hoped that AEMO will provide further detail to allow participants to provide appropriately informed feedback.	Please see previous responses relating to the procurement process.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	Other (Customer load restoration)	Concern to ensure that not only the SRAS objective is met, but that in this process consideration is also given to the ultimate objective of supplying customer load. Hydro Tasmania anticipates that the JSSC will be consulted during this process.	The scope of the SRS does not include the restoration of load. However, the Reliability Panel considered economic assessments of the cost of load not being supplied when setting the SRS for the procurement of SRAS to restore generation and transmission. In undertaking SRAS procurement, AEMO must of course consider single points of failure that could prevent it from meeting the revised SRS, and is aware of its power system security responsibility under NER 4.3.1(p). In relation to load restoration, AEMO plans for that process in developing the regional system restart plans. AEMO currently works most closely with TNSPs in that process, and will invite JSSCs to become more involved. AEMO's proposed rule change regarding confidentiality of SRAS sources may facilitate greater involvement.
Origin Energy Ltd (Origin)	**SRAS 24 hrs Test**	Origin believes that a 24 hour testing window is currently impractical due to a number of existing issues including: a. Rules Compliance: Under NER 5.7.5 a Registered Participant planning to test equipment related to a connection point, which requires changes to normal operation of that equipment, must give 15 business days' notice to the relevant NSP. This requirement alone makes it impossible for participants to comply with the Rules and conduct a 24 hour test. AEMO should assess the types of tests that it would conduct under a 24 hour notice period and determine if it will infringe upon this Rule requirement. b. Co-ordination of third parties: Testing of SRAS involves the co-ordination of multiple parties who need to be fully informed of their obligations and roles in any testing process. AEMO should provide a clear testing procedure for the proposed 24 hour test in the guidelines to ensure participants are fully aware of their obligations. c. Level and extent of the tests to be employed: Guidelines should indicate this including items such as required equipment, identification of affected third parties and the type of generator test. d. Impact on/isolation of plant unrelated to the tests: Requires extensive preparations to ensure in-service units are not affected. This often occurs several days in advance and ensures correct procedures are followed and the risks of a unit trip are minimised. Time of year is also taken into consideration when conducting tests as the risks of a plant tripping or a reduction in station capability can increase given certain weather conditions. Origin notes that AEMO will have regard to market and system conditions and therefore encourages open collaboration with SRAS providers in determining the most appropriate time for a test, to minimise impacts and risks to both participants and the NEM.	AEMO acknowledges the coordination and notice required with the TNSPs and is liaising with them on this. Items to be tested will be included in the SRAS Guideline. Any specific considerations unique to a facility can be addressed in the contract schedule. It is currently proposed that each test would be an end to end test of SRAS equipment to demonstrate start up without external power and energisation of the path to the nominated delivery point. Noted, and AEMO will include reasonable parameters about the timing for the AEMO-nominated test, recognising that the objective is to gain a reasonable level of assurance that procured SRAS are ready for any major supply disruption/black system event if and when it occurs.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	Aggregate Reliability	The incorporation of both individual and aggregate reliability factors provide an additional comparison mechanism available to AEMO when determining the best overall SRAS contract provider for the upcoming contract period. The weighting of each factor will play a key role in awarding contracts and Origin would welcome further detail on the proposed weighting that AEMO intends to employ in its evaluation process.	Please refer to previous responses.
	Determination of electrical sub-networks	Origin is comfortable with the current electrical sub-networks as they appear in the guidelines, especially the special requirements for capacity north of Sydney.	Noted.
Snowy Hydro Ltd	**SRAS Individual Reliability**	Snowy Hydro submits that the start-up performance of the SRAS source is the most critical element in the assessment of the overall reliability of an individual SRAS. The value of system restart sources decreases exponentially with decreasing start-up reliability. In general, large thermal units need to be re-energised shortly after an outage/trip event to minimise the time required to get back on-line. This relationship is non-linear and beyond the first 30 minutes the time required to synchronise the generator plant exponentially increases. SRAS plant with high overall availability but poor start-up performance when the restart source is required may adversely impact on the overall restoration program in a black system event. This was clearly evident by the failure of both restart sources in South Australia during the state-wide blackout. AEMO needs to critically consider amongst other considerations the effect of different SRAS start-up performance and its major impact on the individual reliability of a SRAS source in procuring the right amount of restart services to meet the SRAS objective.	Noted. AEMO notes again that it is virtually impossible to reduce start up performance to a formula that can be equitably applied to all SRAS sources, particular those for which AEMO does not have a history.

Organisation	Category	Issues Raised in SRAS Consultation Stage 1	AEMO Comments
	SRAS 24 hrs Test	a. Snowy Hydro agrees that testing of SRAS capability is central to effective planning for the restoration process, and should simulate real event conditions as far as practicable. Specifically, Snowy Hydro advocates the tests should practically demonstrate that the restart source is able to energise an external network bus and/or an external load. b. A test with not less than 24 hours' notice would be challenging in the NEM's current market environment with high levels of uncertainty due to variations in demand and increasing levels of intermittent generation. While designing an appropriate test with short notice is possible, the opportunity costs associated with running these tests would be higher than tests with longer notice periods. Hence SRAS Providers must be entitled to recover their opportunity costs associated with the 24 hour notice test. This cost will vary depending on the characteristics of the restart source, where it is located in the transmission network, and its exposure to financial contracts.	a. Noted and agreed. b. Noted. Please refer to previous responses on the testing proposal
	Modelling and Assessment	Snowy Hydro notes the Reliability Panel's recommendations in its Final Determination on the System Restart Standard, to increase engagement with key stakeholders, such as network service providers, in relation to its consideration of key elements relevant to its procurement of SRAS. Snowy Hydro advocates that AEMO implements these recommendations and has genuine engagement with all key stakeholders especially TNSPs who have intimate knowledge of the practicalities of switching transmission and distribution network elements.	Noted. AEMO has, and will continue to, engage with TNSPs in relation to the determination of relevant requirements for the SRAS guideline, as appropriate through the procurement process, and of course in the determination of regional restart plans and procedures.
	Determination of electrical sub-networks	Snowy Hydro encourages AEMO to critically assess whether it is more appropriate for NSW to have two electrical sub-networks instead of relying on the additional requirement for a SRAS capable of restoring 500MW of generation capacity north of Sydney.	AEMO has considered whether there is any need to revise the boundaries based on the revised guidance in the SRS (section 7). Based on current information, AEMO has concluded that the current single sub-network in NSW is consistent with the SRS. If any additional relevant information is received by TransGrid, AEMO will assess this. The additional SRS requirement north of Sydney is about the selection of services – it is not related to the viability of sub-networks.

APPENDIX C - SUPPLEMENTARY MATERIAL

Examples are provided below of SRAS equipment and subsequent individual reliability calculations. Note that these examples are for illustrative purposes only. AEMO will seek advice and information from the following participants as they have the best knowledge of their systems:

- Potential SRAS Providers, on SRAS Equipment Availability and Reliability
- TNSPs, on transmission system reliability

These examples focus on calculating the individual reliability with an emphasis on the reliability of components that constitute the SRAS source. It assumes that the SRAS Equipment Availability and other factors to be assessed (see section 4.1.2) are the same between different elements as summarised by the following Table.

Table 1 SRAS Source Individual Reliability Components

			Assumption/Calculation
SRAS Equipment - Availability			(Same for all)
SRAS Equipment - Reliability (also known as expected Start-up Performance)		Points of failure	Calculated in examples
	Other factors	Component age and condition	(Same for all)
		Fuel storage	(Same for all)
		Previous SRAS Experience	(Same for all)
Transmission Component Reliability			Calculated in examples

Example 1. Individual Reliability calculation

Individual Reliability is calculated below (**Figure 2**), for the arrangement shown in **Figure 1**, based on:

- SRAS Equipment reliability, based on one unit that can meet the SRAS technical and capability requirements (Source A)
- Transmission Equipment reliability, based on one CB connecting that SRAS Equipment (Transmission Type 1)

A final Individual Reliability is determined. N.B. This examples assumes SRAS Equipment availability, and 'other factors' contributing to SRAS Equipment Reliability are 100%.

Figure 1 SRAS Equipment and Transmission Equipment configuration

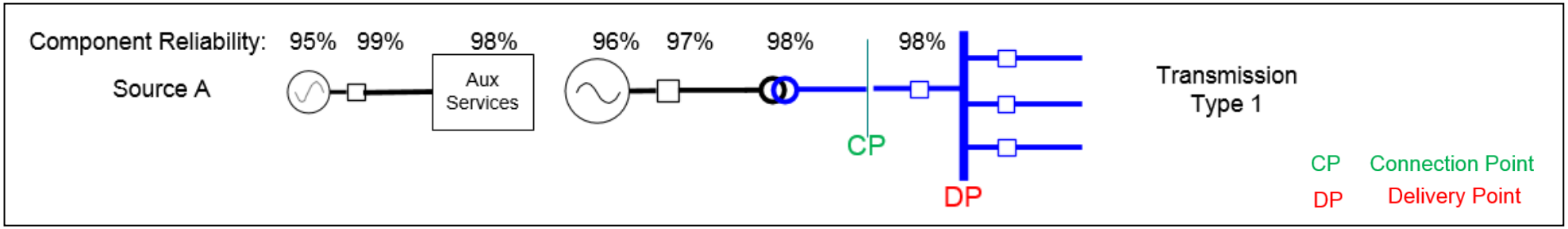

Figure 2 SRAS Equipment and Transmission Equipment calculation

	SRAS Equipment Reliability - Source A	Transmission Equipment Reliability - Transmission Type 1
Equipment reliability data	DG: 95.0% / CB: 99.0% / Aux.: 98.0% / Gen: 96.0% / CB: 97.0% / Txr: 98.0%	CB: 98.0%
Calculation 1	Source, Aux. and Gen. connection: 84.1%	CB: 98.0%

SRAS Equipment Reliability - Source A = 95% AND 99% AND 98% AND 96% AND 97% AND 98% = 95% x 99% x 98% x 96% x 97% x 98% = 84.1%	Transmission Equipment Reliability - Transmission Type 1 = 98%
Individual SRAS Reliability (Source A and Transmission Type 1) = 84.1% x 98% = **82.4%**	

Example 2. Individual Reliability calculation.

Individual Reliability is calculated below (**Figure 4**), for the arrangement shown in **Figure 3**, based on

- SRAS Equipment reliability, based on two units that can meet the SRAS technical and capability requirements in their own right offered as a single SRAS source (Source B). These units have a common initial energy source e.g. diesel generator
- Transmission Equipment reliability, based on two CBs connecting that SRAS Equipment (Transmission Type 2)

A final Individual Reliability is determined. N.B. This examples assumes SRAS Equipment availability, and 'other factors' contributing to SRAS Equipment Reliability are 100%.

Figure 3 SRAS Equipment and Transmission Equipment configuration

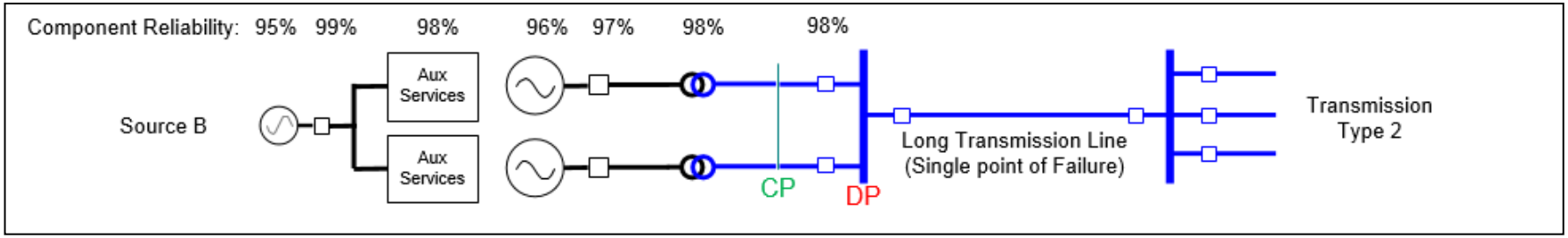

Figure 4 SRAS Equipment and Transmission Equipment calculation

	SRAS Equipment Reliability - Source B	Transmission Equipment Reliability - Type 2
Equipment reliability data	DG 95.0% · CB 99.0% · Aux. 98.0% · Gen 96.0% · CB 97.0% · Txr 98.0% · 98.0% · 96.0% · 97.0% · 98.0%	CB 98.0% · 98.0%
Calculation 1	DG+CB 94.1% · Aux. and Gen. connection 89.4% · 89.4%	CB 1 or 2 98.0% · 98.0%

Calculation 2	DG+CB	Aux. and Gen. connection	CB 1 or 2
	94.1%	98.9%	100.0%
Calculation 3	SRAS Equipment		Transmission Equip.
	93.0%		100.0%

SRAS Equipment Reliability – Source B 95% AND 99% AND ((98% AND 96% AND 97% AND 98%) OR (98% AND 96% AND 97% AND 98%)) = 95% x 99% x (1- (1- (98% x 96% x 97% x 98%)) x (1- (98% x 96% x 97% x 98%))) = 94.1% x ((1- (89.4%)) x (1- (89.4%))) = 94.1% x (98.9%) = **93%**	Transmission Equipment Reliability - Transmission Type 2 (98% OR 98%) = (1-(1-98%) x (1-98%)) = 100% = **100%**
Individual SRAS Reliability (Source B and Transmission Type 2) = 93% x 100% = **93%**	