Notes from SRAS Guideline Forum – 24 June 2020

Version 2.1

This document provides an overview of the main points of discussion at an industry forum convened by AEMO on 24 June 2020 to provide information and invite perspectives and feedback on matters relating to the draft amendments to the SRAS Guideline. AEMO is currently consulting on these amendments following changes to the National Electricity Rules (NER) made by the AEMC on 2 April 2020 (*National Electricity Amendment (System restart services, standards and testing) Rule 2020 No. 6*). Readers please note that:

- This document is a summary only and is not a complete record of discussion at the forum.
- For presentation purposes, some points have been grouped together by theme and do not necessarily appear in the order they were discussed.
- The views expressed at the forum and reflected here are not necessarily those of AEMO.

1.NEM-wide considerations

AEMO started with an overview of the key changes to the SRAS Guideline that AEMO has proposed following the NER amendments. It was noted that the closing date for submissions on the first stage of consultation is 3 July 2020, but this was not the only opportunity for feedback. If stakeholders were keen to discuss any aspects of the draft Guideline further, they could also request a meeting with AEMO in their submission.

Please refer to the slide pack on the AEMO website for further detail.

Two brief introductory perspectives were provided by industry members before the floor opened for wider discussion.

1.1. Perspective 1 - Tesla

Restoration Support service capabilities (Section 3.4) in the SRAS Guidelines.

Topic	Discussion
Self-starting	• Tesla energy storage systems self-contained units (Megapack) • Advantage of batteries is the energy is there. The batteries can start up the AC bus with DC. Traditional systems require energy sources for supporting cooling systems etc. • Tesla batteries can operate in two modes: grid following/grid forming. • It is important that the island is defined, through an island control automatically or through centrally-directed manual switching (current AEMO approach). • Resynchronisation with the system can then be performed manually to PQ mode or automatically. • A grid forming example was discussed. Following a grid failure, the battery auto transitioned to V/f mode to control voltage/frequency more precisely and then returned to PQ once grid returned.
Voltage/frequency control	• Voltage/Frequency forming – local voltage/frequency determines what P and Q to inject into the system. The nominal voltage and frequency can change dynamically, which can be performed easily. • Deadband and droop can be defined. It can be more or less aggressive for SRAS support and flexible for various scenarios. This can also be dynamically changed to have tighter control. • An example of the Hornsdale Power Reserve (HPR) battery was shown during an SA separation event. The HPR battery could respond very fast to provide grid support (transitioned from AGC

	to support the island), then transition back when the SA island was resynchronised with the rest of the network. • This was described as analogous to providing black start and transitioning control to another generator in the restored island. • The nuances and differences between the above example, compared to system restart support, would be in defining what service is necessary, and then testing and integrating with other SRAS providers.

1.2. Perspective 2 - CS Energy

Topic	Discussion
Opening observations	• Expressed a perception that SRAS procurement has previously been cost-based, rather than value-based. • Observed that load restoration is handled at a much more micro level with batteries. – Interested in the impact of harmonics with virtually no load, and whether harmonics from batteries may be an impediment to load restoration. – In the early stages of restoration, particularly for thermal generators, the speed of load restoration and size of load blocks is critical.
Conventional SRAS provision, benefits and challenges	• Coal thermal SRAS providers with the trip to house load (TTHL) feature provide a very effective black start mechanism, although noted that TTHL success rate is only around 50%. – Depending on generating units, TTHL control system drives the unit from minimum load (house load) to stabilising load. This is not under AEMO's control (the control system will drag it up). This puts a lot of onus on AEMO to ensure that sufficient load is available for TTHL. – Quite onerous for the TTHL unit boiler and turbine, it is an automatic system (not reliant on plant operator intervention). Priority is to protect plant (not a runback, it is a trip) for successful output. – The TTHL unit cannot sit indefinitely on house load, compared to batteries. As the high pressure (HP) turbine experiences high exhaust temperatures. The unit will trip after a certain period of time. • Seen retirement of gas plant, and not many gas generators offered SRAS contracts. – Overall perspective is that the SRAS procurement process does not incentivise investment in pony motor/GT to restart gas plant. A GT is a quite a large investment if not being used normally. • Interactions generators have with NSPs (transmission or distribution) is a key issue.
Summary traditional SRAS providers	• Key features of traditional generators are the suite of services they bring- voltage, system strength, fault contribution will be part of the package. • While there is opportunity for traditional generators to provide SRAS services, it is important to understand costs imposed. For example, TTHL is quite an impost on the generator. • Traditional generators will continue to play a role and hydro will be a mainstay for restoration. – Some hydro units are being refurbished and could have a lifetime of 100 years. • With the emergence of new technologies on the system, need to ensure they are compatible from a physics perspective. • Important to have a variety of SRAS suppliers, not all eggs in one basket. • Overall, TTHL and hydro the preferred modes for traditional SRAS.
System Restart Testing (extended network tests)	• Testing regime can be challenging in terms of provision of load blocks and minimum load. • Commend AEMO in pursuing a testing regime. Nothing worse than finding issues during a real black event.

1.3. Discussion

Question/Observation	Responses
Previous procurement process used a reliability factor accounting for individual network and generator reliability and an overall factor. **Has the efficacy of the reliability factor been reviewed? How well has that part of the process worked?**	This is still part of the procurement assessment process, and is required by the Reliability Panel's system restart standard. AEMO has worked with each TNSP looking at risk factors and assigned different weightings to feed into the overall factors. This considered weather related events and other risks. AEMO would welcome any other suggestions on how to improve accuracy of the calculations.
Cyclone season run from November to March. Suspect that the reliability factor covers the entire year. There may be a benefit for a seasonal profile or normalised if prone to cyclones/bushfires. **Is this somehow built into that factor?**	Different NEM regions have different susceptibility, and different parts of regions, therefore AEMO does consider geographic diversity including environmental risk factors. It is a good point and AEMO will revisit whether weightings and calculations for the reliability factor can be improved. It was also noted that we've seen a recent separation event across two sub-networks (SA and part of Vic, also for a long time), which may warrant revisiting overall calculations. Power system events that are or have been seen as unprecedented, are not impossible and are important to consider.
In regard to AEMO's Summer operations paper and what the power system was exposed to at that time. **What would this mean for the SRAS process for location and diversity?**	This is another factor outside of a changing generation mix and we are observing exposure to extreme weather events and natural disasters. The assumptions/inputs provided 3 years ago may no longer be valid. Therefore, it would be worthwhile revisiting to confirm what needs to be modified, to ensure what we are procuring the adequate SRAS to meet reliability requirements (not just of SRAS providers, but accounting for risk factors in the surrounding network too). This includes the impact of exposure to extreme whether events, not just factors related to changing generation or network characteristics.
Originally thought of battery as SRAS restoration support, but not for a black start service. **How long is it necessary for power to be sustained (that would be key for battery to participate as a black start service)?**	AEMO did consider including a timeframe in the Guideline for a black start service to sustain a response. However, there is no one size fits all for all technologies and locational circumstances (e.g. what will the original black start source restart first, and from there what ongoing operation is needed, and for how long, as the restoration progresses from that particular location to meet the system restart standard in the electrical sub-network. For example, a black start source might be a cranker to restore a path which may be only needed for ~30mins. Or it might be needed to support thermal plant over ~2-4 hours. AEMO felt that not specifying a limit will provide flexibility in procuring for each electrical sub-network and the particular circumstances of each location. AEMO welcomes feedback on how these considerations for black start and restoration capabilities can be clarified and improved.
SRAS procurement process seems to inhibit participation of multiple power stations as one service, e.g. a hydro system with multiple downstream power stations. It was suggested that a battery with a wind farm would be capable of providing a service, but do contracts prevent this?	AEMO clarified that this is not the case. Additionally, the black start service definition has now been expanded in the NER to consider services from facilities other than generating units. The service can potentially be provided by a variety of plant, generating units, synchronous condensers, batteries etc. AEMO welcomes submissions on this topic and how the Guideline could be improved, or the black start service capabilities can be clarified.
The SRAS Guideline states that restoration support requires at least two capabilities. Could AEMO provide scope on how major industrial loads can fit into these services?	AEMO is observing a rapid uptake of DER in mainland regions. Dependency for load was mentioned by CS Energy (e.g. TTHL units can only be used for some minutes but then need to be rapidly loaded to a few hundred MW). If downstream load combines with DER, then there is less certainty on how much rooftop PV will be picked up, hence there may be a need in some parts of the network for services that can increase confidence in the availability of 'clean' stable/reliable load. Plant may have dual capabilities that can provide load and generation, and AEMO can consider those capabilities.

Many sensitive loads (such as smelters) would want to be connected as soon as possible and stay connected.

Sensitive loads have certain timeframes to come back online, and are not going to intentionally become unavailable for re-connection.

Therefore could these types of loads provide restoration support service and what if any value would you put on the service?

It would be good see more transparent principles/criteria on when major industrial loads would be considered for services and how to value.

Additional guidance in the SRAS Guideline on these issues to be considered. There are multiple items that AEMO needs to consider for stabilising load support. Most importantly:

- Do we need it (technically) for restoration to meet the system restart standard?
- Is it a capability that we would expect to be there naturally (inherent in the nature of normally operating load and power system equipment), or is there an additional capability that would have to be installed and/or maintained?

Similar to a generator meeting its LBSP or performance standards, during restoration from a black system event AEMO does not consider there is scope for compensating a load for performing as it would normally be expected to do.

The Guidelines could explain the criteria to be applied when considering the need for support services and AEMO welcomes feedback on how this could most usefully be included.

2. Region specific discussions

TNSPs presented their regional perspectives on SRAS and system restart testing in their region or areas where the Guideline may need revision from a TNSP perspective. Questions and discussion were invited after each TNSP overview.

2.1. NSW

Topic	Discussion
Historic overview	• Last time NSW had a black system was in June 1964. This was before back-up protection, where an uncleared fault (CB fail) caused cascading trips. The event occurred around midnight and the power system was restored by 7am. Most NSW residents were unaware of the event. • Highlighted that the number of conventional sources available for SRAS has declined over the years. There may be many reasons for this.
System Restart Testing (extended network tests)	• TransGrid noted there are particular difficulties involved in testing restoration paths that cover large parts of the network to pick up load. • The technicalities and costs are not insignificant and could severely constrain the market and interconnector. • Other challenges arise where there are different parties involved (outside the SRAS provider and TNSP). In those cases the tests become harder to organise and co-ordinate with more participants involved.

2.2. QLD

Topic	Discussion
QLD electrical sub-network boundaries	• Powerlink currently discussing combining QLD sub-electrical boundaries with AEMO. • There are pros and cons in keeping the two sub networks. QLD is a long and skinny network with the southern area quite far from central QLD. • Powerlink thinks the pros of retaining the two sub-networks are: – Can restart two networks in QLD instead of one. – If only one sub-network is affected, the lines are quite long (with no load resulting in high voltages) and therefore require sources in the different sub-networks? – There are sensitive loads in central QLD (aluminium smelter). Powerlink needs to consider re-supplying these loads fairly quickly if there is a chance they can reconnect. • Powerlink concerns of combining the sub-networks: – Can't have two different starting sources to different areas (fictional boundaries). – Can't contract same number of generators for restart (particularly an issue where SRAS generators are out for maintenance). – There are very long lines to re-energise smelter from southern region. • Powerlink raised AEMO's viewpoint on the benefits of combining the electrical subnetworks in giving flexibility to use different contracted services on the day. However, given QLD's geographic topology, it was noted that central sources will look after central part of the network and vice versa for the southern region.
Is the reason to reduce to single network to save money?	• AEMO confirmed that cost reduction plays no part on the proposal to combine the QLD sub-networks. Indeed, reducing the number or diversity of procured SRAS sources across Queensland would not be consistent with the system restart standard. • AEMO's rule change proposal actually included a request to remove the restrictions in the NER that required AEMO to meet the system restart standard at lowest cost. While AEMO's preferred objective was not accepted by the AEMC, there was a change to at least recognise that cost should include long-term considerations. • Rather, AEMO sees limited value in boundaries given the evolution of the network, the actual location of black start sources capable of contributing to the standard (only 4 in QLD), and the safeguards of the diversity and reliability requirements in the system restart standard. Multiple sub-networks in all other regions have previously been combined without reducing geographic diversity. • The aim of combining the sub-networks is to increase flexibility by removing artificial borders that no longer seem to serve a valid purpose and could have practical negative impacts in developing and implementing the QLD system restart plan.

	• Also noted that a single Queensland sub-network may struggle to have load available during a restart event. Even if there two or three SRAS sources in an area, getting load down corridors may be a challenge.
If a path is dependent on a network SVC, is the SVC considered as a restoration support service?	• One of the key aspects of a restoration support service, is whether we need additional help with restoration from plant that is not otherwise assumed to be available or able to provide a particular capability. • As discussed in relation to major loads, AEMO is not expecting to contract and pay for a service that is naturally provided as part of the normal operation of a facility. However, if there is restoration capability we do not have and a plant can be adjusted or made available to deliver that capability, that can be considered as a support service where needed to meet the standard.

2.3. SA

Topic	Discussion
2016 SA restoration experience	• SA has unique challenges. Having experienced a black system in 2016, many learnings could be drawn from this event. ElectraNet also have a fair bit experience operating the region as an island. • Small generators have been procured for SRAS, which then start the bigger generators. The first step in restoration is for TNSP to determine the state of network, that informs which restoration paths can be used. • Previously there was a need to perform network switching in the early stages for SRAS generator restart. This was found to be onerous and time consuming for ElectraNet control operators in the early stages of restoration (particularly so depending on the time of day of blackout). In conjunction with the generator, this switching has now been changed to remove these dependencies. • Following blackout review, ElectraNet investigated changing actuator sources to batteries so as to not be reliant on the AC sources. • Also looked at diesel generators at substations on critical restoration path. Found that in 2016 some substations lost supply for longer than 8 hours, so needed to send someone on site which is difficult if resources are already stretched. Diesel generators now installed to extend life of batteries.
System Restart Testing (extended network tests)	• ElectraNet have performed some more extensive restart testing. SRAS generators in SA are close to the loads which makes testing easier. • There is potential for doing more comprehensive testing but could be intensive particularly if requires involvement from multiple parties. It requires a fair amount of co-ordination and commitment by parties on the day. However, ElectraNet says there is still more they can do to check viability of restart paths. • Testing is important after significant changes. ElectraNet gave an example of a recent extended restart test after the DNSP had performed major substation reconfiguration on a critical restart path. The test verified that energisation can still be successful.

2.4. TAS

Topic	Discussion
Background on Tasmanian restoration	• TasNetworks considers there are three distinct sub-regions in Tasmania: North West, South and North East. • There are procured SRAS sources in each sub-region – noting there is only one SRAS electrical sub-network comprising the whole Tasmania region. • Tasmania is lucky in the number of alternative hydro plant available, which are being maintained for black start. • Potential for the new Marinus link to be another system restart service that could be offered. • Tasmanian load consists of 50% from 4-5 major industrials, captured in the restoration plan. • TasNetworks does not see a need to for load restoration support as an additional service in Tasmania. As the TNSP and DNSP, TasNetworks can access & adjust load to manage stability.
System Restart Testing (extended network tests)	• TasNetworks noted that finding suitable load for pickup in a test situation could be quite challenging.

2.5. VIC

Topic	Discussion
VIC restoration challenges	• Currently there are two procured black start sources. One close to and one electrically distant to the major synchronous generation centre in the Latrobe Valley. • AusNet observed distant sources present a challenge to get supply to thermal generators to get them up and running. Energising long lines with very low load results in high voltage. Most of the transmission network does not have the necessary equipment to keep voltages down. • Once large generators are restarted, then there are challenges picking up stabilising load quickly enough for those generators. Latrobe Valley local load is not enough and so time is critical to get to the Metro area. • AusNet also highlighted the need to avoid too much rooftop PV solar, which is widespread in VIC across the whole region. Once load is picked up, it could be a minute after that when inverters cut in – reducing load which may impact restoration.
System Restart Testing (extended network tests)	• AusNet noted the market impacts of testing, particularly in one proposed case in VIC which could impact an interconnector. Load pickup is also a major issue without risking customer disconnections. • In comparison, restart sources close to large generators can be utilised to restart pump/fans as load.