

27 October 2016

Mr Neville Henderson
Chairman, Reliability Panel
Australian Energy Market Commission
PO Box A2449
Sydney South NSW 1235

Review of System Restart Standard Draft Determination – REL0057

Dear Mr. Henderson

The Energy Networks Association (ENA) welcomes the opportunity and time extension to make a submission to the Australian Energy Market Commission (AEMC) Reliability Panel's Draft Determination on its Review of the System Restart Standard (SRS) of August 2016.

The ENA is the national industry association representing the businesses operating Australia's electricity transmission and distribution and gas distribution networks. Member businesses provide energy to virtually every household and business in Australia.

Technical Evaluation of SRAS sources

The SRAS sources used for the South Australian Black System Restart on Wednesday 28 September 2016 failed to provide black start. One SRAS source failed and a circuit breaker failed to close for the second source. ENA members consider that the probability of such failures is material in black start events. Therefore, it is proposed that the draft standard should require a technical evaluation to be run in parallel with the commercial evaluation during SRAS evaluation and procurement. The aim of the technical review is to conduct a systematic review of both the network and SRAS provider availability and reliability) in order to meet the minimum availability and reliability standard. By contrast, the Standard should not rely on self-assessment.

The technical and commercial evaluations which are currently both undertaken solely by the Australian Energy Market Operator (AEMO) should be undertaken independently of each other and conducted by appropriately resourced and skilled personnel. The jurisdictional Transmission Network Service Providers (TNSPs) should advise and comment on these evaluations.

Other Issues

The ENA submission provides more detail on these and related issues, including:

- » Theoretical assumptions in developing the draft SRS;
- » A systemic decline in the depth of the market for SRAS as a result of the on-going loss of synchronised generation in the NEM;
- » The need to re-focus on greater technical governance for SRAS (including greater transparency and improved communication). This could involve extending AEMO's proposed collaborative approach to potential governance arrangements for emergency under and over frequency schemes where it indicates advice will be sought from TNSPs;
- » Enhanced SRAS testing and stakeholder training; and
- » ENA comments on AEMO's System Restart: Restoration Curves & Generator Reliability - October 2016 document, identifying issues in a number of practices and methodologies.

Should you have any additional queries, please feel free to contact Norman Jip, ENA's Senior Program Manager – Transmission on (02) 6272 1521 or njip@ena.asn.au.

Yours sincerely

A handwritten signature in blue ink, appearing to read 'John Bradley', is positioned above the printed name.

John Bradley
Chief Executive Officer

DETAILED FEEDBACK

1. Lessons from South Australia (Wednesday 28 September 2016)

The 'system black' event that occurred in South Australia on 28 September 2016 has provided an opportunity to evaluate the draft system restart standard against a NEM event. Importantly, the degree to which stakeholder expectations will be met by the draft standard can now be better considered. Based on the review of the current and draft standards informed by the South Australian event, ENA members provide the following feedback:

- » As recognised by a number of parties, the proposed draft SRS as discussed at the Public Forum on 21 September 2016 is a *relaxation* of the current SRS standard.
- » A key element of the draft SRS is the proposed adoption of an "average demand" measure rather than the existing "peak demand" measure, which results in significantly reduced targets (based on some economic analysis and AEMO's load restoration curves).
- » In addition, the adoption of AEMO's Value of Customer Reliability estimates appear to have been accepted across all customer sectors, and therefore are likely to under-estimate the costs of High Impact, Low Probability events on direct-connect transmission customers which are subject to a prolonged outage.
- » The events of 28 September 2016 demonstrate that neither the current or proposed standards were met in practice. Significantly reducing the restart targets would therefore appear counter-intuitive. The events of 28 September 2016 demonstrate two potential failure modes of SRAS and the fortuitous availability of the Heywood interconnector.
- » The reliability of SRAS sources in the NEM's recent past were based on 90% for what were deemed primary sources and 60% for secondary sources. For two primary sources, the probability of both failing would be 1%. For one primary and one secondary source, the probability of both failing would be 4%. Under the draft standard, there is a proposal to move to an "aggregate reliability" of 90% (with the probability of two failures in this case being 1%). On 28 September 2016, neither SRAS source functioned correctly.
- » Certain assumptions in both standards have been shown to be vulnerable to failure. Specifically, the assumption that the restart will occur in a circumstance of 100% network availability appears presumptuous as a network that is 100% available is quite unlikely to shut down. An increase in the frequency and impact of extreme weather in the future will increase the probability that future system events have an effect on the availability of the transmission network. Although such events might be deemed "rare", it is exactly for such rare events that the SRS exists.
- » SRAS sources require much higher levels of testing to ensure the contracted level of aggregate reliability, especially under adverse environmental conditions. The ENA also observes that had it not been for the valuable role played by the interconnector(s) between South Australia and Victoria in being available (although initially de-energised), the already significant state-wide system black would have lasted for days rather than hours.
- » There is significant probability that SRAS which is not co-located with large generation will be of minimal value, particularly in a shutdown caused by transmission-related failures, and
- » It appears that greater preparation, including scenario-based training, could have been enhanced.

Given the above issues, it is difficult to consider that either the current or the draft proposed SRS are fit for the circumstances recently experienced in the black system event in South Australia. ENA recognises that addressing weakness in the current SRS may require a reassessment of the indirect costs and risks borne by the system, given the demonstrable evidence that customers highly value timely and secure system restart after extreme events.

2. Theoretical assumptions in developing the Draft SRS

The ENA and its members have concerns with a number of the theoretical assumptions that have helped shape the draft SRS.

- » The assumptions of 'fail safe' transmission availability in the AEMC's System Restart Ancillary Services (2015) Final Rule does not match international and local experience:
 - Adherence to the AEMC's Final Determination of 2 April 2015 on the System Restart Ancillary Services rule change assumptions on transmission reliability appears to have constrained the analyses underpinning the draft determination findings, and
 - AEMO appears to limit its SRAS assessments within the assumption that all transmission lines are available for service. This is inferred from the footnote on page 41 of the AEMC's 2 April 2015 Final Determination on the SRAS rule change. The footnote states that the Commission notes that this "worst case" black system event reflects a scenario where the transmission network is fully de-energised but remains intact, with all lines available for service
- » The ENA notes that the provision in the draft determination for NSW generation restart North of Sydney, the removal of the 1,000MW requirement for load and generation in a sub network, and the provision of two sub-networks for Queensland demonstrates the shortcomings of assuming 100% availability in the transmission network. The application of electrical diversity appears at odds with the 'fail safe' transmission availability assumption. This shortcoming could potentially exist for the resultant SRAS provided in other sub networks
- » The current and draft standard both work on the assumption that the network will be 100% available following a shutdown. Whilst acknowledging that some "starting point" is required from which to conduct restart studies, the DGA report (produced to assist in the development of the draft standard) stated that *"The blackouts reviewed... were all initiated by unexpected transmission events"*. This was borne out by the event on 28th September 2016, where the initiating event was the loss of multiple transmission circuits
- » ENA also notes that should critical transmission lines be damaged they will impede or potentially stop a restoration process across a jurisdiction. This was exemplified during the events of 28 September 2016
- » The level of economic abstraction underpinning the analysis is mismatched with actual historical experience both locally and in overseas black start incidents. International experiences referred to in Boxes 4.1 and 4.2 (pp. 28-29) of the Panel's Draft Determination are clearly acknowledged, but do not appear to be taken into account in the context of the NEM. DGA Consulting found, based on overseas experiences, that fully restoring the system can take more than 12 hours; some equipment fails; and setbacks do occur during restoration. There is also the clear likelihood that a network failure or incident may have initially caused the supply disruption
- » The need to clearly acknowledge that the network must be operated in a secure state, wherever possible. This requirement to cater for the next credible contingency without exceeding the thermal or stability limits of the network can result in the summated 'available generation capacity' being constrained by the physical limits of the network, and
- » An appropriate level of consideration should also be given to the availability and operability of gas supplies.

Recommendation:

- i. ***Transmission reliability, availability and limitations (thermal, voltage and transient stability limits) are included in the assessment of aggregate reliability and procurement of SRAS.***

3. A systemic decline in the depth of the market for SRAS as a result of the on-going loss of synchronised generation in the NEM

ENA understands, similar to most interested parties involved in the NEM, that the state of the SRAS market is problematic, and does not demonstrate a fully-functional free market. With the potential for the on-going decline of synchronised generation, the positive prospects for growing such a small market remains a structural problem for the NEM. It is arguably very challenging to have an effective commercial tendering process.

The current procurement process does not provide any incentive for a failed tenderer to retain its black start plant. Economically, keeping plant maintained, fuel available and staff trained is a significant overhead that is unlikely to be commercially worth carrying between rounds of procurement. Consequently, the number of sources is progressively decreasing in each NEM region and will presumably settle at two per sub-region.

The ENA is concerned that there are no mechanisms for attracting a new starter into the market, and are also not convinced that greater flexibility as to how AEMO undertakes its SRAS procurement contracting will necessarily address the small sample currently observed in the NEM.

With this background in mind, the general approach to economic and efficient procurement requires review. With an effective duopoly in each sub-region, there can be little or no effective competition. If an economic approach remains an imperative, then a much longer run process is required, allowing whole-of-life considerations to be applied to managing the restart assets. If an economic approach is not required, then a duopoly could be managed in exactly the same way as the TNSP / DNSP monopoly services are managed, with some form of risk-based regulated return for service provision.

Recommendation:

- ii. The Reliability Panel needs to consider how it, and other NEM institutions, will address the matter of sufficient restart sources and market depth in the future.***

4. The need to re-focus on greater technical governance for SRAS (including greater AEMO transparency and improved communication)

The ENA considers system restart is essentially a technical problem. The ability for a source of some description to start itself without any external power available, then progressively energise portions of the network in a controlled manner is fraught with technical issues that must be understood, regularly tested and rehearsed by operational staff. The value of a restart source is therefore a function of a number of factors, including:

- how likely it is to start
- how likely the associated large generator (where appropriate) is to start
- what network elements will be available to the restart source
- how easily that network can be prepared and switched (including reliable operational controls and communications networks), and
- how easily stabilising load can be applied (particularly during the early stages of re-energisation).

A number of these factors are outside AEMO's area of primary expertise so should be determined by the TNSP, in consultation with the DNSP and generators. Studies and simulation exercises could provide accurate assessments, which could then be applied to a "value matrix" to provide an appropriate technical benefit factor to each SRAS source. An expected outcome of this approach would be that sources located remotely would be regarded as far less valuable than sources co-located with large generation, connected by a number of transmission "corridors" to the rest of the network. Once this matrix is determined, AEMO can apply its expertise in the commercial area to determine which source delivers the best overall benefit to the network and the long-term benefit of consumers.

How optimal the commercial arrangements in supporting such outcomes is the focus of AEMO. Under the current procurement arrangements, AEMO is responsible for both the technical assessments (determining the electrical sub-networks, considering service diversity, carrying out system restart modelling, etc.) of the proposed SRAS and for procuring SRAS at minimum costs (best commercial outcome). It appears it has been difficult to manage or make explicit the trade offs when objectively assessing technical aspects and managing financial negotiations and outcomes.

In some cases, the ENA considers that this process has resulted in the procurement of SRAS sources which are intended to restart other potential restart sources. The additional time delays and switching complexity in achieving restoration of supplies has an inherent societal cost or risk which may not be adequately captured in the tender evaluation process.

ENA considers the critical commercial procurement assessments need to be de-coupled from the technical assessments process. TNSPs should become involved in the technical evaluations of the SRAS tender review process, given that AEMO presently considers both the financial and commercial components of SRAS tender evaluations. TNSPs can be effectively utilised when conducting technical evaluations given their detailed understanding of the precise constraints that may exist within their respective networks.

Such an approach would be consistent with the position taken by AEMO on potential governance arrangements for Emergency Under- and Over-Frequency Schemes (as outlined on page 15 of its submission to the AEMC dated 18 October 2016). AEMO suggested that advice be sought from the TNSPs. The ENA would welcome a recommendation from the Reliability Panel that AEMO increases its engagement with TNSPs on the technical limitations of the system, performance of SRAS and the capability of the network in light of these limitations when determining the procurement of SRAS in the future.

An extension of such a collaborative approach could see one possible arrangement whereby a group such as the AEMO-convened National Electricity Market Operations Committee could govern the commercial aspects of SRAS procurement. The Operations and Planning Working Group and the Power System Security Working Group (involving AEMO and TNSPs) could oversight the technical aspects of the SRAS procurement.

At a minimum, there should be reasonable information exchange between AEMO and TNSPs in advising of potential contract sources. This will also assist operational planning and the timely updating of TNSP restart procedures. In general, ENA members support as much information as possible being made available, taking into account confidentiality concerns.

In any deliberations of any such overhaul, the ENA acknowledges that clearer governance arrangements are required. The Panel currently notes that the key focus of the SRS is on the initiation of the restoration process. It does not specifically include a process for restoring supply to consumers following a major outage or power disruption. It appears illogical that under the draft SRS, AEMO is not accountable for the SRS being met (p.20) but is responsible for a series of technical and commercial considerations, including:]

- Advising the Reliability Panel on how to determine the SRS;
- Determining the electrical sub-networks;
- Considering service diversity;
- Carrying out system restart modelling; and
- Procuring sufficient SRAS at minimum cost,

Recommendation(s):

- iii. ***Commercial and technical aspects of the System Restart Standard be de-coupled***
 - ***Technical aspects for System Restart are as intrinsic to the expertise and role of the TNSP, as it is to AEMO. TNSPs should, at a minimum, evaluate the requirement. AEMO should assist in this process, but the outcome must be a consensus view, amongst these parties.***
 - ***To support the above, TNSPs should be required and resourced to carry out such studies and training exercises in order to satisfy this requirement. The results of such studies and participation in exercises will be made available for scrutiny to affected external parties (e.g. generators, DNSPs, and large customers).***

- iv. ***The decision-making process for determining electrical sub-networks should be resolved on a technical basis.***
 - ***The Reliability Panel to provide further clarification of what is meant by “taking into account the following factors” (Paragraph 7 in Draft SRS, and Paragraph 6 in current SRS).***
 - ***TNSPs to provide input regarding the technical aspects of the power system and the difficulties anticipated in re-energising it.***
 - ***AEMO and the TNSP to reach a consensus view on the sub-network boundaries.***
 - ***In the event that AEMO and the TNSP are unable to reach a mutually-acceptable decision, an independent expert to be appointed by the Reliability Panel, from a selected ‘panel’.***

5. Enhanced SRAS testing and stakeholder training

As previously noted, both SRAS sources failed in the South Australian event. A consequential question that will need to be addressed is whether this dual failure was foreseeable. A much deeper approach to assessing “reliability” or availability of sources appears necessary and includes enhanced SRAS testing.

Whilst AEMO provides a level of restart training, most participants would consider that this is at a very “high level” and does little to prepare operational staff for the pressures and unanticipated technical issues that inevitably occur.

A better trained workforce with a deeper understanding of black start issues would place the NEM in a much stronger position, and the South Australian event demonstrates the need for effectively and timely system restart capability. Comprehensive training involving all impacted parties (TNSP, DNSP, generator, large customers as well as AEMO) would allow a wide sharing of knowledge and the dissemination of operational issues that could otherwise stall a restart attempt. Such training is not without cost and, to be effective, would need a reasonable level of investment and commitment.

Recommendation(s):

- v. ***A more extensive testing regime for SRAS sources needs to be developed.***
- vi. ***“Routine testing” to be supplemented by a review of maintenance records, mandatory reporting of routine start failures etc.***
- vii. ***Testing to be extended beyond the source to the generator / network that it is supposed to be capable of restarting (i.e. energising at least the first section of transmission network and at least a theoretical analysis of generator ability to energise transmission elements such as transformers).***
- viii. ***The 7 Panel to instruct AEMO to procure a “training service” from each TNSP. This would allow the TNSP to include this in their next revenue reset proposal. Training scenarios highlight the ‘human factors’ of a black start situation including a simulation of the length of time required to restore transmission elements and manage stabilising load.***

6. ENA comments on AEMO’s System Restart: Restoration Curves & Generator Reliability - October 2016

As part of the consultation process, the AEMC obtained a brief AEMO report entitled “System Restart: Restoration Curves & Generator Reliability – Information Sources and Methodology”. ENA have taken the opportunity to raise a number of issues with this document. These include:

- » Questioning whether contingency analysis assessments were included against the thermal limitations of the network (section.2.5)
- » Section 3.1 point 6 implies that industry would be driving all units towards maximum export, which might not be secure. It also notes a generator ramp rate of 5% per minute to Maximum Continuous Rating. This appears quite aggressive for a unit which has been off-line for some time
- » In Section 3.2 ENA questions AEMO’s assumed proxy for network restoration whereby “*Approximately 5 minutes is allowed to energise one transformer or one branch leading away from the black start generator*” as an accurate representation of the time taken to find suitable stabilising load within a distribution network. Also, in this section, the adoption of a radial restoration of the power system is not considered optimal or desirable, and
- » Failing to include issues such as situation awareness, stress, fatigue, staffing levels, communication links, distance to other generating units, etc. in the overview of the SRAS reliability figure considerations.

ENA Members understand that generator restoration curves used by AEMO may not have received wide support from the plant owners who, with many years of experience of operating the plant, should be regarded as appropriate experts to consult in this area. To achieve confidence in restart planning, it is essential to factor in such expertise into the process. If different views are held, this should at least be made transparent.

Recommendation:

- ix. ***Generator restoration characteristics should be provided by plant operators, based on actual plant performance (as near as possible corresponding to a black start situation).***

Other observations and proposals in relation to the Panel's draft SRS

- » **Private arrangements for sensitive Loads.** In addition to an assessment of the operational impacts of the proposed draft SRS parameters and levels, the Panel has also indicated that in the event of individual sensitive loads requiring "level(s) of protection" over and above that provided by the Draft SRS, *"then a solution is best negotiated between that load, the respective TNSP and generators, as well as potentially with the jurisdiction"* (page 56). In taking such a position, the Panel argues that it is inappropriate for the Draft Standard to outline expectations for the restoration of sensitive and critical loads within a specified timeframe (p.56).
 - The ENA seeks clarification as to what the Reliability Panel thinks is required to give effect to private arrangements. In doing so, it may have to address the potential 'free-rider' problem.
 - AEMO should be explicitly involved in such arrangements, and that there is a likelihood that with a number of 'bespoke/alternate' arrangements such circumstances will certainly complicate restart plans within an electrical sub-network. It would also render the economic analysis performed without any prospective bespoke arrangement, invalid.
- » **Is there a need to re-consider the number of sub-networks in NSW¹ and Tasmania?** For example, concerns still persist as to whether Northern NSW (north of Sydney) can be effectively restarted from the South of the sub-network. If there were to be two electrical sub-networks in NSW, this could remove the need for the special additional requirement in the draft SRS to "procure one SRAS source north of Sydney". In Tasmania, the present SRAS procurement appears to contradict the provision for electrical and geographical diversity.
- » **How AEMO will apply the diversity requirements is uncertain.** AEMO's determination of sub-networks may still produce unexpected results unless stronger guidance is provided to AEMO in applying the new standard. One approach could involve AEMO publishing its methodology for consultation in determining the number of sub-networks and then working with TNSPs (as per the Panel's recent recommendations) to come to a consensus approach to the number and relevant boundaries of the electrical sub-networks.
- » **Is it inconsistent to not rely on interconnectors in the draft SRS, but approve an SRAS source that is physically located within a different sub-region?**
- » **Section 2.1.3 of the draft determination refers to the causes of major supply disruptions, but fails to mention extreme or severe weather.** Bearing in mind the number of severe weather events in the last 10 years and potential climate risk, such events are likely to increase. Therefore, any analysis that does not factor in an increase in more extreme weather-related events could be seen as optimistic. As a case in point, the trigger of the black system event in South Australia on 28 September 2016 was severe weather conditions. With on-going weather concerns this led to the proclamation on 29 September 2016 of a period of Emergency in South Australia under the Essential Services Act (1981) that lasted for nearly, if not, a fortnight. This declaration was to ensure the production, distribution and supply of electricity in the State.
- » **Consideration of security when determining (i.e. modelling and simulating) the restoration paths of the restoration curves is important.** There is the prospect that TNSPs and/or generators might be directed by AEMO under such circumstances. ENA members caution that to do so in an insecure manner may be quite problematic.
- » **Consideration of the Operator response time in the determining the restoration curves.** A number of ENA members have identified that during overnight shifts and public holidays there is only one operator on-line. This will impact on both response and estimated restoration times.
- » **The South Australian restoration experience demonstrates the potential usefulness of the formation of viable 'islands'.** Under a Network Support Agreement, Port Lincoln has three generating units that are

¹ In a 25 January 2013 AEMO [Issues Paper](#) entitled, "System Restart Ancillary Services Issues and Options Paper" AEMO noted that "No studies [to determine the expected timeframes to restore auxiliary supply to power stations and restore generation as set out in the (then) System Restart Standard] were carried out for New South Wales because combining the existing two electrical sub networks into one was considered to be impractical due to the distances and loads involved. The requirement to restore the sensitive load in the Hunter Valley area was also considered".

capable of supplying the local load when the primary network connection is unavailable (AEMO, Update Report of 19 October, p.26). The ENA supports the draft standard to mandate that existing and new support agreements be included in the restart strategy during the contractual life of a SRAS agreement. Network synchronising points must be included in the plan to utilise these viable islands. These Network Support Agreements should not be counted as a potential source for black start for the purposes of SRAS evaluation or procurement.

- » ***The accuracy of the modelled/simulated generation restoration curves used in the determination of the SRS levels require further clarification.*** Specifically, the meaning of “restored auxiliaries generation capacity” and “restored generation capacity” needs further explanation.
- » ***It is unclear if the actual/historical reliability of transmission elements will be included in AEMO’s determination of aggregate reliability, diversity and strategic location of services.*** In particular, the application of the 100% reliability assumption for transmission elements can nullify the AEMC Reliability Panel’s intent in clauses 4, 8 and 9 of the draft SRS, that attempt to address these issues.

Additional Proposal

- x. ***In relation to the Panel’s additional recommendations on sub-station batteries - this section should be updated from “battery requirements” to “emergency supply requirements”, to enable a mixture of both diesel backup and battery backup for control, protection, and communication systems to meet the requirement for a minimum period of time, typically 10 hours.***