Hydro Tasmania
The power of natural thinking

18 December 2015

By electronic submission

Reliability Panel
PO Box A2449
Sydney South NSW 1235

Attention: Mr Neville Henderson

Dear Neville,

Submission to: System Restart Standard – Issues Paper

Hydro Tasmania appreciates the opportunity to comment on the System Restart Standard (SRS) Issues Paper and includes further detail with our submission as attached.

Hydro Tasmania is very concerned that the Australian Energy Market Operator's (AEMO) procurement of only one System Restart Ancillary Services (SRAS) for Tasmania (previously three) exposes the State to an unacceptable level of risk. AEMO's 2015 SRAS procurement approach poses the following major risks to the State:

1. No SRAS coverage for up to 10% of the time;
2. No SRAS coverage for the majority of the State if AEMO are unable to restart relevant substations or transmission lines are unavailable, where these are single network points of failure; and
3. Possible separation of the transmission system between northern and southern Tasmania during a restart event which will expose the southern sub-region to an extended black-out.

By not having redundancy measures in place for the contracted provision of SRAS in Tasmania, should a system black occur, there is increased risk that industry sensitive to outage durations may not be restarted by AEMO in a timely manner. This may result in major interruptions or even cessation of their operations, which will be detrimental to the economy of Tasmania.

Hydro Tasmania believe that the studies undertaken by AEMO, based on system modelling, do not take sufficient account of the operational issues associated with restoring the power

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system and therefore underestimates the risks and anticipated times for system restoration.

Hydro Tasmania's submission recommends to the Reliability Panel that the SRS should be changed so that a more realistic level of SRAS is procured.

The key issues which we believe need to be addressed relate to the consideration of diversity of SRAS sources and the assessment of a timely power system restoration.

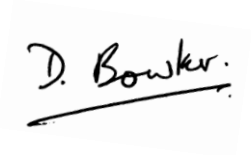
This submission also advocates the case for adopting:

- at least two SRAS in Tasmania (for the multiple reasons identified in our submission);
- appropriate recognition of sensitive load restart time requirements and that priority should be given to sensitive loads in the restart process.

Hydro Tasmania proposes that the new SRS should become effective immediately after its determination and not be delayed until the next tender process, in order to reduce Tasmania's current black start risk.

Please contact Prajit Parameswar on (03) 6230 5612 if you would like to discuss any matters associated with this submission.

Yours sincerely



David Bowker
Manager Regulation

Hydro Tasmania's Submission

Overview

This submission contains two parts. The first part makes some observations which are very important to Tasmania including:

- Tasmania's need for at least two SRAS
- The more general need for an n-1 approach
- The need to recognise the specific needs of sensitive loads

The second part of the submission responds to the specific questions which have been posed in the Issues Paper.

Tasmania's need for at least two SRAS

The Tasmanian power system consists of a number of remote and semi-remote generators connected by single and, in some cases, double circuit transmission lines to seven major Extra High Voltage (EHV) switchyards located in the south, north and west of the state. Generally the transmission connections between adjacent EHV switchyards are relatively strong, as are the transmission connections from the major switchyards to the major domestic and sensitive industrial load centres. As the transmission connections use common corridors or are located close together for significant distances the risk of losing multiple connections is relatively high.

Hydro Tasmania's experience from two Tasmanian black system events that occurred in December 1979 and in January 1994 indicate that relying on a single SRAS to initiate power system restoration is risky. We note that the nominated black start station in the December 1979 system black failed to start despite regular testing of its black start capability. Further, the assumption that the transmission and major substation infrastructure remains intact and undamaged cannot be guaranteed. For example, in the 1979 event there was a major explosion in the Tungatinah switchyard which remained undetected for many hours which frustrated restoration and in the 1994 event an isolator in the Sheffield switchyard failed during switching and while a known event, still resulted in restoration times of just under 2 hours for sensitive loads and well beyond the 4 hours for other critical domestic loads. It should be noted that power stations were manned during these two events and multiple power stations were used to restart the system.

The Tasmanian power system is now interconnected with mainland Australia's power system via the High Voltage Direct Current (HVDC) Basslink interconnector. However, as

Basslink cannot restart the Tasmanian power system, Tasmania will be totally dependent on its locally sourced SRAS for a system restart.

Hydro Tasmania believe that the studies undertaken by the Australian Energy Market Operator (AEMO), based on system modelling, do not take sufficient account of the operational issues associated with restoring the power system and therefore underestimates the risks and anticipated times for system restoration.

It is Hydro Tasmania's view that the assessment for Tasmania should be based on a more realistic set of operational assumptions in order to properly determine the number of SRAS required to restart the Tasmanian power system. We believe that an allowance should be made for some measure of redundancy to counter unexpected events. Unexpected events include such things as the unavailability of, or the failure to start nominated SRAS as well as the possible loss of a transmission corridor or critical substations.

Hydro Tasmania has undertaken its own studies, incorporating past experience and an intimate knowledge of the Tasmanian power system which confirms that the conclusions reached by AEMO, based on their system studies, is highly optimistic and provides no redundancy to cope with unexpected transmission or switchyard events or even the SRAS unavailability period.

While it is acknowledged that the current Tasmanian transmission network has been strengthened since the 1979 and 1994 events, with only one contracted SRAS the Tasmanian Power System is vulnerable if;

- the nominated SRAS is unavailable or fails to start; and/or
- the transmission connection to the nominated SRAS is not intact (especially if the transmission connection is a single point of failure); and/or
- the switchyard infrastructure required to support the start-up of other generation and the reconnection of both the domestic and sensitive loads is damaged.

In all the above situations an alternative SRAS would need to be found and activated delaying the restart. This delay and the delay associated with implementing an unplanned restoration will potentially see restoration occur well outside the SRS, possibly putting at risk the future of certain sensitive Tasmanian loads and result in an unacceptable short and long term economic loss coupled with significant social disruption within Tasmania.

Given this, Hydro Tasmania strongly recommends that the SRS be structured so that AEMO is required to procure a minimum of two SRAS with appropriate geographical and electrical diversity. This diversity will ensure that a black Tasmanian power system can successfully

restart and return supply to sensitive loads and the broader system within an acceptable time frame.

The more general need for an n-1 approach

It is common practice in the electricity industry to adopt an n-1 philosophy. This means that any contingency caused by a single failure will be accommodated by ancillary services or operational processes.

In approaching the procurement of SRAS in Tasmania, AEMO have adopted an "n" approach where potentially a single failure could cause significant problems. As noted above, even a station which has been tested may not work on the day. More specifically, the fact that there is a system black is an indicator of a significant disruptive event. In the light of this there is arguably even a case for an n-2 approach given the likely widespread disarray from the causal event.

The current SRS in Section 7 requires AEMO to have some diversity ("…there shall be diversity in the SRAS procured…"). It is unclear to Hydro Tasmania how the current procurement has met this diversity requirement. The issue for the revised standard is that if the Panel believes that diversity and an n-1 approach is valuable, the new standard must ensure that the diversity requirement is clearly stated and implemented.

The need to recognise the specific needs of sensitive loads

The impact of an extended outage beyond a few hours on many smelters and potentially other businesses is out of all proportion to the costs experienced by normal businesses. The loads of these businesses are also such that alternative standby arrangements are not practical. The current standards do not recognise the needs of sensitive loads.

We propose the panel consider having a specific standard for restoration times for nominated loads (including sensitive loads) which may suffer potentially disproportionate losses in the event of a system black. To ensure restoration times are met, we also propose that the sensitive loads are appropriately prioritised in the restoration procedures.

Responses to Questions from Issues Paper

Question 1 - Time and level of restoration

1. **Are the existing timeframes for restoration appropriate (i.e., 1.5 hours for restoration of station auxiliaries of generating units that can supply 40 per cent of peak demand in the sub-network and 4 hours for generation capacity equivalent**

to 40 per cent of peak demand)? If the timeframes are not appropriate, how should they be amended?

Response: Hydro Tasmania supports a more output related measure which means that the 1.5 hours intermediate standard for generator auxiliaries can be dispensed with.

The 4 hours appears to be a realistic standard but we believe the panel should try and assess its validity. In addition, where appropriate at a sub-network level, an intermediate time frame (such as the 1.5 hours) may be required for restoration of sensitive loads.

Economic Cost of Black System Events

In considering the time limit of 4 hours, Hydro Tasmania's view is that the focus must be on how the cost of SRAS relates to the more important minimisation of the expected economic costs to the market.

As a result Hydro Tasmania has undertaken a review of the economic cost of black system events that have occurred in other international markets. It is clear from this review that the current cost of Australia's National Electricity Market (NEM) SRAS is very small in comparison with the economic cost associated with actual black system events. For example, the 14 August 2003 system black that affected the Mid-West and North East USA and Ontario, Canada took some 2 days to restore at an estimated economic cost of some $10 billion.

Frequency of Black system events

Hydro Tasmania has also undertaken a review of black system events that have occurred in major power systems in developed countries over the period 1980 to 2013. What is clearly apparent from the statistical information is that the number of black system events in the period 2000 – 2013 has almost doubled when compared with the number of events in the period 1980 -2000. It was not possible from our review to establish with any certainty why such a significant increase occurred apart from the fact that there appeared to be an increase in black system events associated with natural disasters. However, what the review does highlight is that the probability of such black system events has increased suggesting that the probability weighted cost has increased.

Hydro Tasmania believes the panel needs to consider whether 4 hours a reasonable surrogate, on average. Three specific factors which Hydro Tasmania believes have been underestimated are the increased time needed by thermal stations to restart as time without power increases, the increasing dependence of developed countries on the continuity of a supply of electricity and the consequent disruption and costs when that supply is interrupted.

2. **Do stakeholders consider that the restoration level be maintained at 40 per cent of peak load? If not, what other restoration level should be considered, and why (e.g. a different percentage rate, or average demand instead of peak demand)?**

   Response: Hydro Tasmania supports the use of 40% of the maximum load.
   With the proper number and diversity of SRAS sources and well planned restart processes this appears to be a reasonable target.

   3. Is the powering of auxiliaries as an intermediate step a necessary part of the definition of the Standard? What are the costs and benefits of removing the intermediate step and moving to a single timeframe for power system restoration (e.g., restore 40 per cent of peak demand within 4 hours)?

   Response: Hydro Tasmania agrees that the intermediate step should be removed.
   With the diversity of different generation technology mixes and network configurations in various sub-networks the enforced timing of the intermediate step of powering the auxiliaries is not appropriate. In a system with a high penetration of hydro or gas generation for instance, there may be other steps that are more critical to meeting the overall restoration timetable. The objective function should be to restore supply to customer loads (prioritising sensitive loads). In sub-networks where this timing is critical it can be included at the restart planning level.

Question 2 - Aggregate reliability

1. **What factors should the Panel consider in determining the level of aggregate reliability?**

   Response: The level of aggregate reliability has been of concern to us. With a single service, the aggregate reliability is only 90%. At a simplistic level, this means there is a one in ten chance of a region with only one service not having restart services available when they are needed. This is of particular concern for Tasmania which does not have the alternative of an SRAS from an adjacent sub-network to restart the system. To be effective we believe the aggregate reliability should be much

higher than 90% (this is supported by the procurement of at least two SRAS in Tasmania).

2. **Would it be appropriate for the Standard to include a minimum number of SRAS services in each sub-region? What are the costs and benefits of doing so?**

   Response: With a single service, the aggregate reliability is only 90%. With two services, each with a reliability of 90%, it should be possible to achieve near 100% aggregate reliability. There are consequently significant benefits of having two services and it allows for the good electricity practice of n-1 contingency to be met (as mentioned above).

Question 3 - Regional variation

1. **What types of technical matters or limitations are likely to impact on achieving the Standard?**

   Response: In Tasmania, as it is likely to be in other areas, there has been a significant reduction of field personnel over the last decades in both generation and network areas. This lack of personnel in the field is likely to significantly limit the operational flexibility and recovery from a system black event. In addition, in Tasmania, remote locations pose particular problems if the event were to occur in the winter with issues associated with potentially limited access. Additionally there is a natural geographic split of load between the North and South of Tasmania which also supports the need for at least two SRAS (historically this has been catered to by AEMO's procurement of SRAS up until the most recent procurement period).

   The assessment of the restart process and the consequent level of SRAS procured needs to recognise these limitations.

2. **Are there any sub-networks in regions of the NEM where specific technical matters or limitations may be relevant to the Panel's determination of the Standard, including any potential variations to the Standard for any specific sub networks?**

   Response: The issues around the Tasmanian network have been highlighted earlier in the submission. The specific technical matters for Tasmania are the inability to provide any support for restart through an interconnector and the vulnerability of a single local restart service to a single event.

3. **What types of economic circumstances or considerations should the Panel be mindful of when determining the Standard? How do they relate to the Standard?**

Response: One factor which may need attention in the Panel's consideration of the standard is the increasing time that thermal plants require to recover once they have tripped. Recovery of the plant can be quick for short duration trips (say less than an hour). However, restoration times will be much longer once significant cooling of the plant has taken place.

4. **Are there any sub-networks with specific economic circumstances, such as the presence of sensitive loads, that the Panel should consider when determining the Standard, including any potential variations to the Standard for any specific sub-networks?**

Response: The disproportionate loss which sensitive loads experience has already been noted above.

Question 4 - Sub-network guidelines

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

Response: AEMO's current arrangements are that Tasmania be treated as a single electrical sub-network rather than retaining the previous arrangement where Tasmania is considered as two electrical sub-networks for SRAS. AEMO undertook a review of the number of electrical sub-networks required in Tasmania, as recently as late 2011, with the conclusion that two electrical sub-regions were required. It is difficult to understand why AEMO's opinion has suddenly changed.

As AEMO is aware, for instance, the transmission network connecting the north and south of the State shares common corridors for extended lengths which pass through and adjacent to heavily timbered areas that are exposed to significant bushfire activity during summer periods. Thus an event in any of these common corridors has the potential, with only one SRAS, to result in either the north or south of the State remaining without supply for many hours. Unfortunately, such an event is not fanciful as in January 2013 one of the main transmission corridors was affected by a major bushfire which had the potential to cause the transmission lines in the corridor to be de-energised so as to allow fire fighters safe access to areas adjacent to the transmission lines.

In the case of Tasmania, where there is no possible SRAS source from outside the state, with a single SRAS there is a significant chance of being unable to restart the Tasmanian Power System.

Given this, Hydro Tasmania strongly recommends the sub-network guidelines should lead to the retention of two electrical sub-networks in Tasmania or that the diversity guidelines be utilised to ensure that there is not a single point of failure.

In addition the selection of particular SRAS should be set up to appropriately take into account the position of sensitive loads. Earlier we have suggested an alternative

standard for these loads and the consideration of the locations for SRAS including the likely impact on sensitive load restoration times.

Question 5 - Diversity Requirements

1. **Do stakeholders consider the existing diversity requirements in the Standard for the procurement of SRAS by AEMO to be appropriate?**

   Response:

   With respect to the individual factors to consider for diversity the following points are made:

   (a) Electrical: As noted in the earlier comments this is a key factor, if for instance a particular key transmission corridor is unavailable a nominated SRAS may be electrically isolated and not be able to contribute to energising the major part of the sub-network.

   (b) Technical: The SRS explanation of "*diversity in technologies shall be considered to minimise the reliance of services on a common technological attribute*;" appears so broad as to offer little guidance. With the complexity of modern systems what are the particular concerns about technical diversity that need to be addressed? It would seem necessary to expand on these guidelines for them to offer any guidance.

   (c) Geographical: Hydro Tasmania agrees that as noted in the SRS this is a reasonable approach to minimise potential impact of natural disasters.

   (d) Fuel: The SRS explanation "*of diversity in the type of fuel utilised by services shall be considered to minimise the reliance on one particular fuel source"* is noted. This note seems to conflate type of fuel and source of fuel. If the fuel is sourced locally then two stations using the same fuel type may still be regarded as having independent sources. As with the other parameters the same principle of avoiding a single point of failure should apply.

   As detailed above Hydro Tasmania believes that diversity in sources of SRAS is a key attribute which can significantly reduce the contingency risk which is not addressed at all if only one service is contracted for a sub-region.

   We propose that the concept of contingency is the appropriate approach to ensure some rigor around the diversity criteria. The concept of contingency considers risk scenarios (addressing the relevant diversity elements) so that SRAS should be

procured on an n-1 basis to ensure there is no vulnerability to any single contingency.

Where AEMO have chosen to contract one SRAS in a sub-region it appears that the current diversity requirements in the existing SRS has not been addressed at all. Hydro Tasmania has written to AEMO to seek clarification on this point.

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

   Response: See response above.

Implementation Date for the New SRS

Hydro Tasmania proposes that the new SRS should become effective as soon as is practical. More specifically, if the new standard requires more SRAS, there can be no justification for running the system for a period of time when the new standard is not met. Under the current rules, AEMO are able to purchase more SRAS if it is needed so there is no reason not to meet the new standard soon after the standard is determined.