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Dear Mr Anderson

AEMO Submission - Draft Distribution Determination for SA Power Networks 2020-25

Thank you for the opportunity to comment on the AER's draft decision on SA Power Networks' (SAPN) distribution determination for 2020-25.

AEMO has been working with SAPN and ElectraNet to analyse the adequacy of under frequency load shedding (UFLS) given high levels of distributed energy resources (DER). South Australia is at the forefront of emerging DER-related challenges. DER increased in South Australia by 185 MW in 2018-19. Projecting forward, with continued rates of growth, South Australia could reach zero operational demand within three to four years – and operational challenges may be encountered much earlier. Additionally, in 2018-19, South Australia reached a record minimum operational demand of 599 MW. For 2019-20 to date, the new record is 458 MW, set on 10 November 2019. New record minimum operational demands are anticipated each year as levels of distributed PV continue to grow in SAPN's network. It is therefore timely to investigate power system operability in low demand conditions, so that appropriate action can be taken if required.

AEMO's analysis shows that if no action is taken, the capability of UFLS to arrest major frequency disturbances may be compromised. AEMO's submission also draws upon preliminary analysis around reducing minimum demand levels in South Australia.

It is AEMO's view that the provision of the Electricity System Security contingent project is integral and essential to ensuring that the appropriate tools are in place to address the requirements of a high DER power system and ensure the best outcome for consumers.

AEMO also supports the AER's draft decision to include a Flexible Export limits project.

AEMO notes that in order to integrate DER (as well as other resources within the system) more effectively and efficiently, broader reforms are required. Such measures are currently being progressed in partnership with the ESB to:

- Move towards ahead and two-way markets, with the appropriate incentives to leverage resources across the system to meet consumer needs,
- Put in place appropriate capability to ensure optimal DER technical performance,

- Support battery schemes to leverage the various roles this could play to support the energy system and respond to market signals, and
- Support tools to enable relevant parties to have visibility of and manage optimal use of DER resources.

Within this framework, appropriate operational tools and capability will also be required to leverage all power system resources, to deliver energy in line with our objectives to maintain power system security and reliability, utilising an incentive-based approach, while adding value for consumers.

SAPN's revenue determination proposed the 'Electricity System Security' project, which includes measures that AEMO's analysis indicates will assist with the first stages of mitigating the issues associated with increased DER on UFLS. The proposal does not fully mitigate the operational issues associated with managing a system with high DER but involves relatively low-cost "no regrets" measures that can be deployed over the coming years, to improve the capability of UFLS and assist with the management of minimum demand periods so that more comprehensive solutions can be developed and deployed. The UFLS measures are complementary to the broader reforms and will also provide benefits into the longer term.

AEMO is also working with the Western Australian government, and other interested stakeholders, on a program of work to effectively manage DER into the wholesale electricity market (WEM), much of which is applicable to South Australia especially when considering periods where South Australia is operating as an electrical island. In Western Australia the introduction of distributed storage resources, and other equipment to enhance system security is now being delivered.

Within this context, AEMO's comments are limited to two aspects of the SAPN regulatory proposal:

1. Implementation of Flexible Export Limits for DER, and
2. The proposed contingent project which includes work to implement changes to the SA Under Frequency Load Shedding (UFLS) scheme (the 'Electricity System Security' project).

AEMO has been working with SAPN and ElectraNet since 2017 on the studies and analysis required to identify and quantify the need for these measures. AEMO considers that both measures are necessary to enhance and maintain secure power system operation. More details on each are provided below.

1. Flexible Export Limits

AEMO supports the AER's draft decision to approve this work program.

AEMO needs the ability to actively manage generating unit dispatch to maintain interconnector and intra-regional line flows within applicable limits. As the proportion of demand met by DER grows, AEMO's ability to maintain system security will diminish in the absence of active DER management tools. SAPN's new capabilities for dynamic DER integration, including dynamic

export limits, are an important component of the suite of additional capabilities AEMO, SAPN and ElectraNet will require to manage operational issues and maintain system security.

AEMO's preliminary analysis indicates that South Australia is approaching the relevant system limits, and they are likely to be breached within the next five years if action is not taken. Further analysis is underway at present to more precisely quantify the timeline of challenges, and to identify the wider range of other complementary actions that may be required, in addition to flexible export limits.

2. Contingent Project - Under Frequency Load Shedding ('Electricity System Security')

SAPN's proposed 'Electricity System Security' contingent project aims to address the impacts of DER on SA's system security, including the UFLS scheme. This submission only deals with matters relating to the maintenance and restoration of UFLS capability (emergency frequency control services) in the immediate future, as directly relevant to the SAPN revenue proposal as part of the 2020-25 pricing period.

AEMO notes that the AER's draft determination does not approve this contingent project.

AEMO's analysis of SAPN data since 2017 indicates that there will be periods where insufficient net load is available to be disconnected in SA under the UFLS scheme to respond to a significant multiple contingency event. Current expectations are that this will start to occur in the 2020-25 regulatory control period. AEMO and SAPN have jointly identified a range of potential actions to mitigate the impacts of DER on UFLS effectiveness. The 'Electricity System Security' contingent project covers some of those actions.

This submission responds to the AER's reasons for its draft decision, providing AEMO's perspective on system security matters in relation to the contingent project.

2.1. SA UFLS issues

Key findings from our current analysis of UFLS in SA include:

1. DER has already reduced the amount of net load available for shedding under the SA UFLS under certain conditions,
2. As DER levels increase, action is required to maintain the capability of this critical 'last line of defence' emergency scheme to respond to such non-credible events, as contemplated by the NER, and
3. Some UFLS feeders are likely to move into reverse flows and this could act to escalate an under-frequency disturbance, rather than help to correct it. AEMO's analysis indicates that as early as the current financial year, nearly half of the UFLS stages¹ could be in small levels of reverse flows in some periods.

AEMO, in consultation with SAPN and ElectraNet, has developed a recommended plan of work to slow this deterioration and help to restore UFLS capability. This includes:

¹ A UFLS stage consists of one or more feeders designed to trip at a specific frequency setting.

1. Full re-design and rebuild of the existing UFLS scheme, leading to the determination and implementation of a new EFCS settings schedule for South Australia under NER 4.3.2(h). This includes the addition of as much load as possible to SA's UFLS scheme, while maintaining an appropriate balance between regions under different conditions², and
2. Disarming UFLS relays when distribution feeders are operating with significant reverse flows ('dynamic arming'). This requires progressive replacement of relays as they approach identified thresholds.

Work will continue between AEMO, SAPN and ElectraNet to confirm the nature and timing of the risks and, as required, develop suitable detailed mitigation options (including those above, and possibly further options in addition) to refine and deliver the proposed program of work. This further analysis will support the detailed design of solutions, as an input to the RIT-D required as part of the trigger for the proposed contingent project to proceed.

SAPN's proposed 'Electricity System Security' contingent project also includes \$0.5 million for the establishment of DER shedding capabilities.³ AEMO supports this inclusion, so implementation can proceed if AEMO's analysis finds urgent implementation of DER shedding capabilities is necessary for power system security. AEMO's investigation is currently ongoing, and preliminary indications are that such capability may be required in the 2020-25 Regulatory Control Period. AEMO therefore supports this being included in the contingent project, so it can proceed if the appropriate triggers are met.

2.2. Regulatory obligations

The AER's draft decision highlights the assumption raised in the SAPN proposal that AEMO would 'place a regulatory obligation' on SAPN to implement the project.

AEMO does not anticipate that it would be placing any additional regulatory obligations on SAPN. Rather, AEMO expects SAPN to comply with its existing obligations. AEMO's analysis is indicating that the actions outlined in the contingent project will be required for SAPN to comply with its existing obligations (given the changes occurring in the power system).

AEMO's power system security responsibilities include ensuring that appropriate levels of contingency capacity reserves are available to arrest the impacts of a range of significant multiple contingency events (NER 4.3.1(k)(2)), coordinating the provision of EFCS by Network Service Providers (NER 4.3.1 (pa)), and, as appropriate, to refer information to registered participants in relation to significant risks to the power system where actions to achieve a resolution of those risks are outside the responsibility or control of AEMO (NER 4.3.1(n)).

² SAPN, 2020-25 Revised Regulatory Proposal, [Attachment 5](#), pg. 91. Adding new loads onto the UFLS constitutes the third change in addition to the two previously raised in SAPN's Original Proposal. This change will involve costs to add new customers to the scheme.

³ SAPN, 2020-25 Revised Regulatory Proposal, [Attachment 5](#), pg. 92.

As a Network Service Provider, SAPN has a number of complementary obligations to assist AEMO in meeting its power system security responsibilities. These include a generic cooperation obligation (NER 4.3.4(a)) and obligations specifically in relation to UFLS (NER S5.1.10.1)⁴.

As indicated above, the detailed changes that may be required to the SA UFLS are yet to be developed⁵. The joint program of work will determine the changes that will most effectively facilitate ongoing compliance by SAPN with NER S5.1.10.1. These may include revisions to the UFLS scheme settings for South Australia in accordance with clause 4.3.2(h) and (ha), and other agreed changes to facilitate achievement of the required objective.

On this basis, AEMO considers that:

- SAPN has existing and clear regulatory obligations under the NER to undertake the work outlined in the contingent project, if the trigger conditions are met,
- AEMO's analysis outlining the detailed work required would be a trigger condition for the contingent project but would not create new regulatory obligations, and
- For the same reason, there would be no relevant regulatory change event that could trigger a pass-through determination.

2.3. Cost benefit analysis, alternative and holistic options

The AER's draft determination also indicated potential lack of consideration by SAPN of alternative or holistic options as a reason why SAPN's proposed contingent project was not accepted.⁶ The Draft Determination also notes that the AER was concerned that other options, which may address changes to the UFLS scheme, may also generate possible interactions with other DER management projects, to deliver a least cost option in line with SAPN's regulatory obligations.

While this is a matter for SAPN, it is AEMO's understanding that a full options and cost/benefit analysis will be performed as part of the RIT-D (required as part of the trigger for the 'Electricity System Security' project).

Through our preliminary studies, AEMO recommended the dynamic arming option⁷. AEMO found that dynamic arming will have a permanent benefit for SA system security. As noted above, the proposed 'Electricity System Security' project will not fully mitigate the problems associated with increased DER on UFLS but involves relatively low-cost "no regrets" measures that can be deployed over the coming years to improve the capability of UFLS and assist with management of minimum demand periods so more comprehensive solutions can be developed

⁴ Each Network Service Provider in consultation with AEMO must ensure that sufficient load is under the control of underfrequency relays or other facilities where required to minimise or reduce the risk that in the event of the sudden, unplanned simultaneous occurrence of multiple contingency events, the power system frequency moves outside the extreme frequency tolerance limits.

⁵ The complex and novel techniques required to model power system behaviour in heretofore unforeseen situations requires further examination before they are used to develop a specific and detailed action plan.

⁶ AER, Draft Decision, [Attachment 5](#), October 2019, pg. 102.

⁷ These factors also informed our recommended plan of work in section 2.1.

and deployed. This action will provide additional time to develop and test options to improve system security and minimises negative impacts on customers.

SAPN's revised regulatory proposal subsequently considered two further options to implement this recommendation (option 1 utilising existing protection relays where possible, and option 2 upgrading all relays to the current standard). The difference between the options is the extent of functionality and speed of operation.⁸

In relation to a holistic approach to managing DER, AEMO confirms that the identified work program to address shortcomings in the UFLS scheme is unrelated to SAPN's other proposed DER integration programs, including:

1. Enabling flexible export limits,
2. Quality of supply work, dealing with over/under voltage, flicker and harmonics,
3. LV monitoring, and
4. Voltage regulation involving replacement of a limited number of zone substation transformers, to allow SAPN to better regulate feeder voltages during times of high PV generation.

These work programs are all unrelated to the ability of the UFLS scheme to meet requirements under the NER. Adding customers to the UFLS, adjusting frequency trip settings and the UFLS design, and implementing dynamic arming of UFLS relays should not interfere with SAPN's other DER integration work. Other measures to manage system security may be identified as AEMO's review proceeds.

If you would like to discuss this further, please contact [REDACTED], Group Manager Systems Capability on [REDACTED]

Yours sincerely



Mr Tony Chappel
Chief External Affairs Officer

⁸ SAPN, 2020-25 Revised Regulatory Proposal, [Attachment 5](#), pg. 91-2.