10 February 2017

Ms. Leslie Guy
Secretary of the Committee
South Australian Legislative Council Select Committee on the State-Wide Electricity Blackout and Subsequent Power Outages
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Adelaide, SA, 5000

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Dear Ms. Guy

Energy Networks Australia submission – South Australian Select Committee's State-Wide Electricity Blackout and Subsequent Power Outages Inquiry

Energy Networks Australia welcomes the opportunity to provide evidence to the South Australian Select Committee's State-Wide Electricity Blackout and Subsequent Power Outages "Blackout" Inquiry. This is in response to direct correspondence sent by the Select Committee to Energy Networks Australia, dated 18 January 2017.

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

Energy Networks Australia recognises the significant disruption to the South Australian community, businesses and industry caused by the 'System Black' event.

The response will briefly address the Terms of Reference (ToR), namely:

a. Causes of the blackout;
b. Delays in recovering electricity supply to all parts of the State;
c. Credible warnings of the potential for such an event;
d. Costs to households, businesses and the SA State economy;
e. Lessons learnt from the blackout; and
f. Any other relevant matters.

Some of the information contained in our written evidence has been provided in consultation with our South Australian member businesses, ElectraNet (electricity transmission), SA Power Networks (electricity distribution), and Australian Gas Networks (gas distribution). We would be pleased to assist with any additional information that may assist the Committee.

a) The causes

A report released on 14 November 2016[1] by the Bureau of Meteorology (BOM) found that a supercell thunderstorm and tornadoes with wind gusts of up to 260km/h destroyed major transmission lines in the state's north, triggering the 28 September 2016 blackout.

Evidence collected by the BOM has confirmed that the F2 Wilmington tornado cut a direct path across the Davenport - Belalie/Davenport - Mt Lock transmission lines, destroying five transmission towers. The report[2] also found that the F2 Blyth tornado was in the vicinity of the Brinkworth - Templers West transmission line at the time two transmission towers were destroyed.

At a high level, these extreme weather conditions resulted in a number of system faults on the transmission system and three transmission lines being brought down. In response to these faults and voltage reductions, a sustained reduction in wind generation occurred. This saw the Heywood interconnector attempt to import more power from Victoria to such an extent where the interconnector tripped (disconnected), leaving an overall significant imbalance in SA's native electricity demand and supply situation, with a consequent frequency collapse. This sequence of events resulted in the 'System Black'.

Energy Networks Australia notes that South Australia has now suffered six extreme weather events since July 2016, with electricity infrastructure repeatedly impacted by strong winds, heavy rain and lightning strikes. On Wednesday 28 December 2016, severe storms delivered some of the worst damage ever seen to the electricity network in the Adelaide Hills, impacting 160,000 customers. This was the largest recorded power outage event on the SA Power Networks system - in terms of average minutes of lost supply (SAIDI). In fact, that single event resulted in more minutes of lost supply than SA Power Networks usually sees in a whole year.

The Bureau of Meteorology recently issued its Annual Climate Statement 2016 , which confirmed a year of extreme weather events. During 2016, Australia had its fourth warmest year on record, 0.87 °C higher than average. Annual rainfall was 17 per cent above average but the regional outcomes were very patchy. Adelaide residents had their wettest year since 1992 and second-wettest year on record and Sydney, Canberra and Hobart had above average rainfall.

[1] http://www.bom.gov.au/announcements/sevwx/
[2] Refer to http://www.bom.gov.au/announcements/sevwx/sa/Severe_Thunderstorm_and_Tornado_Outbreak_28_September_2016.pdf

b) Delays in recovering electricity supply to all parts of the State

Energy Networks Australia considers that the electricity network service providers acted promptly to achieve the safe and earliest possible recovery of supply to customers following the System Black event.

The Heywood Inteconnector played a significant role in enabling System Restart, which was necessary to enable major power stations to come back online. The unavailability and inability of some generation units to support a system restart is discussed in the AEMO report, *Black System South Australia: 28 September 2016 - Third Preliminary Report*[3] .

ElectraNet undertook extensive and complex switching to restore the power system between Victoria and Torrens Island in SA, while managing safety impacts of the event. SA Power Networks facilitated load restoration in a progressive manner under instruction from AEMO. AEMO has indicated that by 2030 hrs (four hours after the Black System), approximately 40% of the load that was available for restoration was restored. By midnight on 28 September 2016 (7.5 hours after the Black System), approximately 1,000 MW or 80–90% of load that could be restored had been restored.[4]

Approximately one third of the forecast load in the northern part of the network was delayed due to damage to the transmission network and was connected over a number of days as soon as this could be safely completed following repairs to the transmission network were completed.

In addition to the damage to ElectraNet's transmission networks, SA Power Networks' electricity distribution network was also impacted by the thunderstorms and severe weather. However, in many cases the distribution network was damaged after transmission supply was lost. As a result, the damage/faults on the distribution network were unknown until electricity supply was restored to the transmission connection points, which supply the distribution network. Consequently, there were delays in restoring supply to some customers until the faults on the distribution system were located and repaired.

Without diminishing the significant disruption, inconvenience and distress power outages cause to customers, it is clear the general impact for the State's population would have been significantly greater if not for the commitment of the workforce of the relevant network businesses (ElectraNet and SA Power Networks (SAPN)).

Additionally, a number of interstate network businesses provided rapid responses to requests for support, including the utilisation of emergency equipment such as spare transmission towers.

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[3] AEMO Black System South Australia : Third Preliminary Report, December 2016
[4] Ibid.

The severity of the storm caused extensive damage to the distribution system, affecting around 90,000 customers (approximately 10 per cent of customers) who experienced, on average, a further six hours without electricity supply, after the transmission supply was restored.

c) Credible warnings of the potential for such an event

Public Information

The Committee would be aware that a number of meteorological services (e.g. the Bureau of Meteorology (BOM) and Weatherzone), as well as publicly available media sources and outlets were reporting on, and monitoring, the forecast extreme weather. For example, News.com and the Australian Broadcasting Corporation published the following articles on 27 September 2016 and 28 September 2016, respectively.

"Extreme weather to lash Australia bringing flooding rain, severe storms, heavy snow and then heat"[5], and

"South Australia weather: 'Cyclone' expected to hit state"[6] - Updated 28 Sep 2016, 4:12pm

AEMO's Day to Day System Power Security Role

Under the National Electricity Rules (NER), AEMO and Network Service Providers have core system security roles and obligations. One key area is in identifying and managing *Abnormal conditions*. NER Clause 4.2.3A outlines **Re-classifying contingency events**, whereby Sub-clause 4.2.3A (a) defines:

> *"Abnormal conditions* are conditions posing added risks to the *power system* including, without limitation, severe weather conditions, lightning, storms and bush fires".

Further, Sub-clause 4.2.3A (b) states that:

> *AEMO* must take all reasonable steps to ensure that it is promptly informed of *abnormal conditions*, and when *abnormal conditions* are known to exist *AEMO* must:
>
> (1) on a regular basis, make reasonable attempts to obtain all information relating to how the *abnormal conditions* may affect a *contingency event*; and

[5] http://www.news.com.au/technology/environment/extreme-weather-to-lash-australia-bringing-flooding-rain-severe-storms-heavy-snow-and-then-heat/news-story/59570d06cac3477594c0e2edcf2a44d6
[6] http://www.abc.net.au/news/2016-09-28/south-australia-weather:-cyclone-and-flood-watch-expected/7883104

(2) identify any *non-credible contingency event* which is more likely to occur because of the existence of the *abnormal conditions*.

As a result, AEMO regularly interacts and is in constant contact with *Transmission and Distribution Network Service Providers, Market Participants*, *Jurisdictional System Security Coordinators* and relevant emergency service agencies in informing their decision-making processes in assessing the potential risks of an impending contingency event.

Changing climatic conditions

As noted recently in a submission to the Senate Select Committee into the Resilience of Electricity Infrastructure in a Warming World, climate change will increase the potential for extreme weather events which may impact Australia's electricity system. It creates the increased frequency and severity of extreme weather events and related risks, including storms, heatwaves and bushfires.

A number of national and international initiatives have concluded that energy network infrastructure and services are potentially highly vulnerable to changing climatic conditions, particularly changing frequency and intensity of extreme weather events, such as drought, heatwaves, bushfires and extreme rainfall.[7] Hotter, longer heatwaves could increase peak load days, longer dry spells and lightning strikes increase the risk of bushfire ignition, and hotter conditions may impair water use for generators.

Attributing any individual weather event to climate change is inherently controversial but few would argue climate change will increase the frequency and intensity of extreme weather events. The CSIRO notes that climate change is already having scientifically observable effects on extreme events in Australia – notably an increase in fire weather, record-breaking temperatures and heatwaves[8]. It forecasts that extreme rainfall events that lead to flooding are likely to become more intense and the number of tropical cyclones is projected to decrease but with a greater proportion of intense cyclones. In the United States, the US Department of Energy has recognised that the frequency and intensity of storms are increasing, concluding that 7 of the 10 most costly storms in US history occurred between 2004 and 2012.[9]

[7] Refer Energy Networks Australia, Climate Risk and Resilience Manual, 2014.
[8] CSIRO, Australia's Changing Climate
[9] *Economic benefits of Increasing Electric Grid Resilience to Weather Outages*, Executive Office of the President, August 2013.

d) Costs to households, businesses and the State economy

Energy Networks Australia recognises the significant quantifiable and non-quantifiable costs of blackouts to Australian customers. In the case of this event, Energy Networks Australia is aware that Business SA considers the blackout cost around $367 million. The Committee could ascertain accurate aggregate financial impacts of the event via confidential industry/specific business' requests from those parties significantly impacted, over and above what is available via Business SA. This could be accompanied by general equilibrium modelling to examine economy-wide Input/Output modelling outcomes.

e) Lessons learnt

A critical component of the restoration of supply, after such an event, is the coordination of operations between AEMO, ElectraNet and SA Power Networks. AEMO, ElectraNet and SA Power Networks have regular meetings to discuss system security matters (e.g. system black events). In addition, both ElectraNet and SA Power Networks' network operators are trained and undertake refresher training to ensure that under a 'System Black' event they are prepared to restore supply to customers as soon as practicable.

Energy Networks Australia understands that on-going reviews by AEMO and the Australian Energy Regulator are taking place concurrently. Some of the important lessons learnt, *to date*, include:

- Wind farm generator ride through

In AEMO's third preliminary report (12 December 2016), it admitted that it was not aware that some wind farms may not be capable of riding through multiple successive faults on the network. Wind turbines have protective features that result in a significant power reduction if they experience more than a pre-set number of voltage dips within a two-minute period. This information was previously unknown to AEMO. The report states this information was not provided to AEMO in the National Electricity Market connection process, nor is it included in AEMO's operational and planning modelling. Latest information in this report outlines a reduction in wind farm output of 456 MWs, from nine wind farms north of Adelaide over a period of less than seven seconds.

The Essential Services Commission of South Australia (ESCoSA) is currently undertaking a review of the licensing conditions of inverter connected generators (e.g. wind farms). ESCoSA is considering retaining or expanding the additional conditions of inverter connected generators. ESCoSA requested AEMO's advice on this matter. AEMO's subsequent report recommended retaining the existing additional conditions and contemplates expanding the conditions on generation licences to include:

(i) Frequency control;

(ii) Rate of change of frequency; and

(iii) System strength.

Further, AEMO considered that these additional requirements and the current additional conditions on wind farms should be expanded to all inverter-connected generators.

Energy Networks Australia supports AEMO's report to ESCoSA on this matter, subject to broader national review processes into market frameworks for system security currently being undertaken by the Australian Energy Market Commission.

» **Declining status of traditional Inertia, synchronous generation, and System Restart Sources**

Energy Networks Australia are enabling the transformation to a cleaner National Electricity Market (NEM). In South Australia, with very high penetration of renewables and the loss of synchronous generation, there is an increased awareness of the inertia services which support system stability and the need to ensure System Restart Ancillary Services can be provided.

» **Greater recognition of System Restart Standard testing and requirements**

Energy Networks Australia welcomes both the Australian Energy Market Commission's Reliability Panel recommendations in its Final System Restart Standard (December 2016) and AEMO's third preliminary report recommendations (12 December 2016) to improve system restart testing and training. AEMO's intended engagement with: (i) the SA System Restart Working Group (p.89), and (ii) stakeholders to determine whether the NEM Control Room can develop a more sophisticated forecasting system to predict extreme wind conditions, including tornadoes, is supported.

» **Support and engage in key NEM Institution Reviews**

Energy Networks Australia and our members are keen contributors to, and supporters of, current reviews by the AEMC, AEMO and the NEM Security Panel chaired by Professor Alan Finkel AO on related System Security issues.

f) Other relevant matters (also other related issues)

Energy Security

Energy security issues should be addressed at a national level - as recognised in the October 2016 establishment of the recent Blueprint to Energy Security in the National Electricity Market (NEM) "Finkel" Review, following the SA 'System Black' event in question. Energy Networks Australia would also encourage the Committee to endorse a robust, nationally consistent approach to estimating the Value of Customer Reliability (VCR).

According to AEMO's 2015 VCR Factsheet, a VCR measure usually in the form of $/KWh indicates *"the value different types of customers place on having reliable electricity supplies under different conditions … Understanding how customers value power supply reliability is an important input into efficient infrastructure investment decision-making over the longer term".*

To underpin, such an approach, the Committee should also consider recent analyses by:

(i) the Independent Pricing and Regulatory Tribunal of NSW's Supplementary Final Report on Electricity transmission reliability standards – December 2016) that endorses such an approach, and

(ii) the recognition by the Tasmanian Energy Security Taskforce's December 2016 Interim Report correctly identifying that energy security and the level of energy reliability should reflect the willingness of customers to pay for an optimal balance of energy 'insurance'.

In undertaking such an examination, the VCR should be considered in a national context with the scope for some regional/locational variability.

Regulatory Investment Test – Transmission (RIT-T)

The Committee should also consider supporting frameworks to address, and plan for, those risks, which are not well accommodated by existing VCR assessments, such as High Impact, Low Probability events. This was clearly recognised by the Council of Australian Governments' (COAG) Energy Council's most recent (14 December 2016) Communique on potential changes to the current Australian Energy Regulator's Regulatory Investment Test for Transmission.

The Communique records that (Energy) Ministers agreed to a number of improvements, *"including ensuring that system security and emission reduction goals are adequately considered; [and] low probability but high impact events like the South Australian system black event in September are appropriately taken into account"* (p.2).

Such improvements should help to ensure that these economic assessments are fit for purpose and supports the need for greater interconnection in a decarbonised world.

Electricity Network Transformation Roadmap

Australian energy networks have partnered with the national science agency, CSIRO in a landmark study, the Network Transformation Roadmap to enable better outcomes for energy customers. The two-year analysis produced a comprehensive plan to keep the lights on, bills affordable and decarbonise electricity.

It finds that a coordinated approach to the changes in the energy system can deliver: more choice and control for Australian energy customers, while maintaining system security and meeting international climate change commitments. In fact, CSIRO analysis confirmed

- Australia's electricity sector could exceed its share of current national carbon abatement targets, achieving 40% below 2005 levels by 2030.

- It is possible for the electricity sector to maintain a reliable, stable grid while achieving zero net emissions by 2050, in line with the aspiration of the COP 21 Paris Agreement.

The Roadmap sets out measures which could see 10 million participants using the grid as a platform for energy exchange, customers saving over $414 per year on average, total savings of $101 billion in system expenditure and zero net emissions for the electricity sector by 2050.

Realising these opportunities relies on strengthening, not undermining, national energy market institutions and markets in which investors – whether they are utilities, new innovators or households – can make decisions without unnecessary policy risk.

The Key Concepts report considers future impacts of emerging technologies on power system security and we would be pleased to provide any additional information to the Committee.

Intermittent Generation options

Energy Networks Australia advises that there may be future opportunities to embed small generation units in the power system as small-scale partners for intermittent generation. This solution would be particularly relevant at the extremities of the South Australian electricity network, where they might provide cost-effective benefits.

The important role of gas

While it is recognised the Inquiry's ToR are focussed on electricity systems, Energy Networks Australia urges the Committee to take a holistic, systemic and technology neutral approach to energy transformation, and include consideration of the role of gas and gas networks in ensuring the ongoing reliable supply of energy. Specifically, the Committee is encouraged to recognise that:

- Australia's gas sector currently provides a significant contribution to meeting Australia's energy requirements providing energy diversity and security benefits with low carbon intensity. In the future, electricity system modelling indicates it will provide a significant supporting role enabling increased penetration of variable renewable energy sources at transmission and distribution scale,
- Within South Australia, gas provides 35 per cent of the energy used in households for only 9% of the total household emissions from energy consumption; and
- There is an international focus not only on the contribution gas can make to reducing emissions today but that options exist for to achieve deep decarbonisation with gas infrastructure through biomethane injection, hydrogen applications and carbon sequestration.

Should the Committee require any additional information, please feel free to contact Norman Jip, Energy Networks Australia's Senior Program Manager – Transmission on (02) 6272 1521 or via e-mail: njip@energynetworks.com.au.

Yours sincerely,

JOHN BRADLEY
Chief Executive Officer