Security and Reliability Council

28 September 2016 South Australia outage

The implications for the New Zealand power system from the 28 September 2016 South Australia outage and black start

28 March 2017

Note: This paper has been prepared for the purpose of the Security and Reliability Council (SRC). Content should not be interpreted as representing the views or policy of the Electricity Authority (Authority).

1 The purpose of this paper is for Transpower to summarise its understanding of the implications of the 28 September 2016 South Australia power outage for the New Zealand power system

1.1 The Security and Reliability Council (SRC) functions under the Electricity Industry Act 2010 include providing advice to the Electricity Authority (Authority) on the reliability of the power system.

1.2 At its 19 October 2016 meeting, the SRC had an impromptu discussion about the 28 September 2016 South Australia event. As a result of that discussion, the SRC created an action for "…the secretariat to arrange for the SRC to receive a paper (likely from Transpower) on any security or reliability lessons for New Zealand from the South Australia incident."

1.3 This paper fulfils that action. The purpose of this paper is to present Transpower's report and to obtain any related feedback from SRC members.

2 Questions for the SRC to consider

2.1 Transpower's report is attached to this cover paper. Representatives from Transpower will attend the SRC's meeting to briefly recap the paper and be available to respond to the SRC's questions.

2.2 The SRC may wish to consider the following questions.

Q1. What questions, if any, does the SRC wish to ask of Transpower's representatives?

Q2. What further information, if any, does the SRC wish to have provided to it by the secretariat?

Q3. What advice, if any, does the SRC wish to provide to the Authority?

SO Report - SRC - South Australia 2016

South Australia Black Start Event

System Operator

Transpower New Zealand Limited

[Report Date]

Keeping the energy flowing

TRANSPOWER

Version	Date	Change
1	28 March 2017	Report Complete

	Position	Date
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IMPORTANT

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INTRODUCTION

This paper contains initial observations on the 28 September 2016 system black event in South Australia and Transpower's assessment of the immediate implications in the context of the operation of the New Zealand power system.

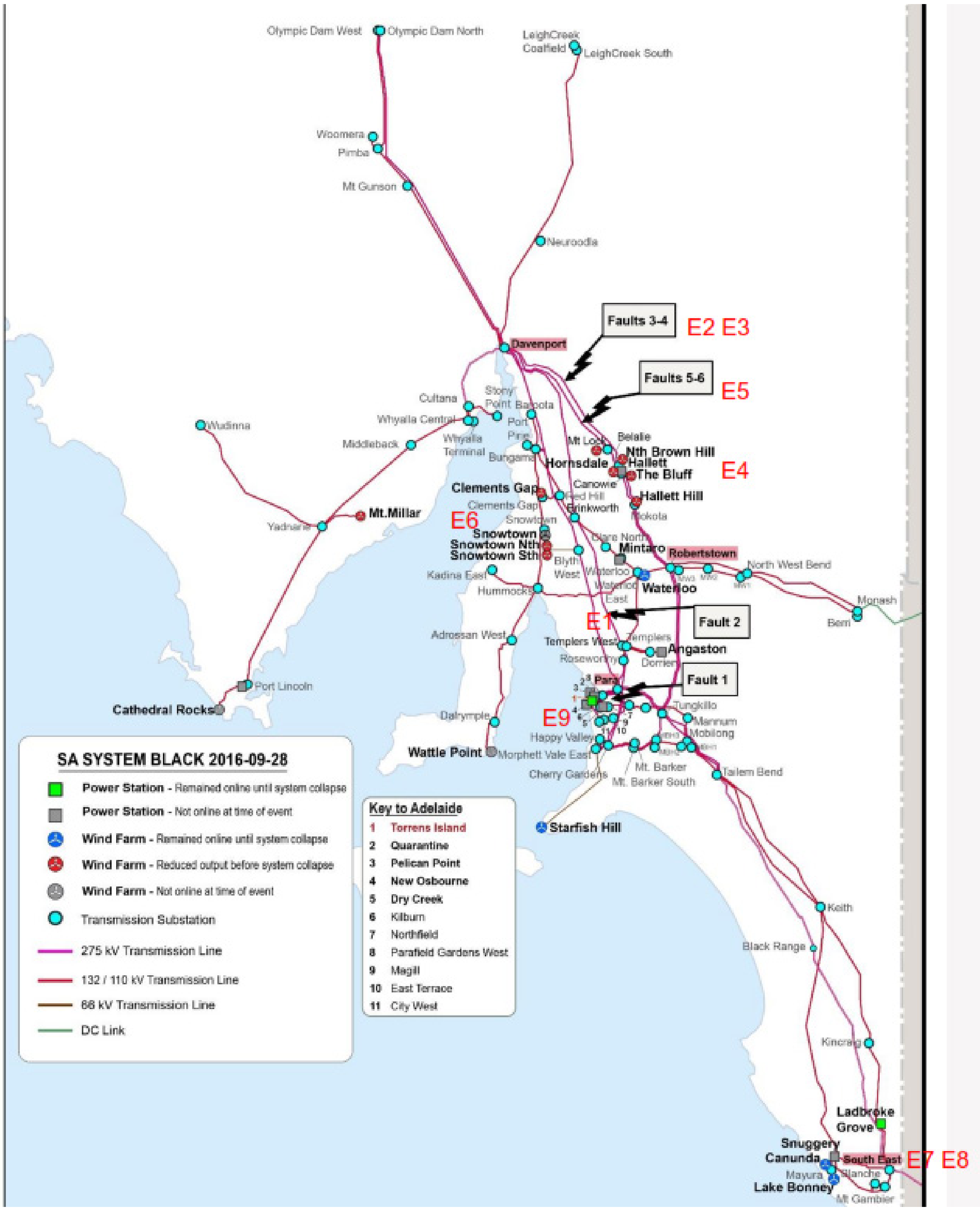
There are some matters of interest for us from the South Australian event, in terms of size its impact is similar to a potential power system event disconnecting all supply to the upper part of the North Island above Hamilton. It includes the loss of electricity supply to a major city. Auckland and Adelaide have similar populations. Australian Electricity Market Operator (AEMO) issued an updated preliminary report on 19 October 2016 including detail on the performance of wind generators during the event. Further investigations are underway by AEMO to confirm additional details of the event and identify recommendations. Our own engineers reviewed the information available shortly after the event to identify and understand the likely cause and any immediate implications.

EVENT DETAIL

Prior to the event on 28 September 2016 the South Australian power system was operating in a stable and balanced manner. The demand for electricity within the State (approximately 1800 MW) was met by thermal generation (18%), wind generation (48%) and transfer from the state of Victoria via two interconnecting transmission lines or interconnectors (34%).

The power system cascade failure event occurred over a period of less than three minutes. It was triggered by multiple faults (momentary electrical short circuits on transmission lines each resulting in a sudden dip in system voltage) during a weather event over a short period within South Australia. The series of faults resulted in a halving of wind generation output. The power system was kept in balance by an immediate increase in the electricity imported on the main interconnector to Victoria, which overloaded it and threatened the stability of the entire eastern Australian system. This potential instability resulted in the main interconnector being automatically disconnected.

Demand for electricity was now two and half times that able to be supplied by the thermal and remaining wind generation within the State and through the smaller of the two interconnectors to Victoria. An automatic system to rebalance the power system by rapidly shedding demand (under frequency load shedding) was unable to respond effectively and the remaining generation and interconnector disconnected resulting in a black system.



The New Zealand Context

There are parallels between South Australia and our own power system, as well as differences.

- We have wind farms with similar turbines and rely on the HVDC link to interconnect the North and South Island power systems. Grid connected wind generation provides 5% of annual electricity generation and can supply up to 25% of North Island electricity needs at any instance.
- There are three windfarms in New Zealand with turbines similar to those that reduced output in the South Australia event. In New Zealand we already schedule additional reserves cover the secondary loss of these windfarms due to multiple disturbances from system events. We

are working with the windfarm owners on control setting changes in light of changes made to windfarm settings in South Australia after their event.

- The HVDC Bi-pole link is a single transmission line that interconnects the North and South Islands. It is a critical element of the power system and depending on system conditions can provide up to a third of the North Island electricity demand and almost half the South Island demand. Should the HVDC Bi-pole link fail suddenly we also rely on automatic under frequency load shedding (AUFLS) as our main mitigation against a black system in the North or South Island. However, our high voltage direct current (HVDC) interconnecting link has operating advantages over the alternating current (AC) interconnector used as the main South Australia to Victoria connection. The overloading scenario experienced is not applicable to our link.
- Extensive technical studies on the adequacy of our North Island AUFLS under a wide range of HVDC link loss scenarios were carried out between 2010 and 2012. AUFLS was found to be adequate to cover almost all scenarios. A recommendation was made to refine the load shedding arrangements to enhance performance. This recommendation is being implemented as part of the Electricity Authority Extended Reserves Project currently due to be completed in 2018.
- The recovery from the system black event in South Australia was potentially delayed by the failure of a Black Start provider. In New Zealand we have two providers in each Island. All four are hydro stations with the added capability to restart without a grid supply. Our four yearly testing regime for each provider is onerous and requires not only a station restart, but to also energise a section of grid as well. We will review the reasons for provider failure against our own testing practices.
- Restoration to the north of Adelaide was impacted by damage to transmission towers (21) and lines (3). In our response to transmission tower damage we utilise both emergency towers (complete towers ready to assemble) and temporary towers (Lyndsay towers) located at four strategic locations. These have been successfully deployed to restore the loss of towers on the HVDC line and other events (as in Marlborough on 21 January 2017). Information from this event will help inform our own plans, particularly the loss of multiple towers.

CONCLUSION

While the South Australian and New Zealand power systems face some similar risks, from the information available to date it appears the likelihood of an event occurring in New Zealand with similar sequence of triggers leading to total collapse of one Island is unlikely, given the mitigations and operational controls presently in place. We expect further more detailed reviews currently underway to provide insights into both power system operation and emergency restoration practices as well the appropriateness of our asset standards.