Initial Assessment of NZ Power System Susceptibility to a South Australia Type Event

Transpower New Zealand Limited

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IMPORTANT

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1 INTRODUCTION

Following the South Australian "System Black" event of 28 September 2016, Transpower has undertaken an initial review of the known events, as described in two reports issued by the Australia Energy Market Operator (AEMO). Our review was to understand if the New Zealand power system, its assets and operation make it susceptible to a similar event occurring here.

2 SYSTEM SIMILARITIES AND DIFFERENCES

Similarities between the South Australian power system and New Zealand's National Grid include a generally linear network with significant renewable generation (South Australia is up to 48% wind) remote from a few significant demand centres. The major difference is that New Zealand's renewable mix which is predominantly hydro rather than wind (North Island wind makes up around 25%). Our base has a greater proportion of higher inertia generating sources such as hydro and geothermal, and our interconnecting capacity is a centrally located bi-pole HVDC link.

3 EVENT SYNOPSIS

Prior to the event on 28 September, the South Australian power system was operating in a stable and balanced manner. The demand for electricity within the State 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 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 South Australian power system was kept in balance by an immediate increase in the electricity imported on the main interconnector to Victoria. This increase overloaded the interconnector causing it to automatically disconnect. This resulted in the demand for electricity now being two and half times more than that being able to be supplied by the thermal generation, remaining wind generation within the State and through the smaller interconnector 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.

In the subsequent restoration of the South Australian system, two issues of note were the failure of a contracted provider to assist in restarting the grid and the inability to restore the full grid as a result of transmission line damage due to the high winds.

4 OUR VIEW

We have identified five key areas of relevance to our power system and its operations covering how the system was configured, asset capability during the event and restoration performance. These are:

- definition of credible contingent events
- management of generation and interconnector risk and adequacy of reserves
- voltage disturbance ride through capability

- AUFLS performance in lower inertia systems
- black start restoration preparation and effectiveness.

Until the final report is published, we have only been able to undertake a high level assessment of our own policies, standards and operations with regard to managing the risk associated with similar multiple circuit disturbances occurring on the New Zealand power system. Our comments are:

- our credible (pre-contingent) event definition allows for the loss of multiple circuits and generation from windfarms during events similar to that experienced in South Australia.
- the HVDC bi-pole risk is managed as a credible Extended Contingency Event through reliance on Automatic Under Frequency Load Shedding (AUFLS) and additional under-frequency. reserves. This includes procuring additional reserves during times of high wind generation to mitigate the risk of wind turbine voltage disturbance ride through.
- joint work with asset owners to identify and improve asset ride through capability. This is to ensure assets can remain connected to the power system during a disturbance and not pose an additional risk during power system disturbances.
- we are currently working with the Electricity Authority to fine tune existing AUFLS arrangements (the Extended Reserves project) to provide greater surety of AUFLS response for the loss of the HVDC link under conditions of high transfers and lower system inertia.
- our ongoing black start procurement and testing procedure and restoration procedures continue to be reviewed and exercised to provide assurance an effective power system restoration response is available should it be required.

5 CONCLUSION

In summary, New Zealand is an islanded power system similar in size to the South Australia power network. However, the New Zealand power system has more synchronous generators connected, therefore having a higher inertia than the South Australia power system. Based on our present understanding of the South Australia event and our system design and operation, we believe that a similar sequence of triggers leading to a total collapse of either the North or South Island, although possible, is very unlikely. This assessment will be updated when final reports on the South Australian event are available.