



Insights from 2016 South Australian Blackout

Overview

2016 SA Blackout - event summary and contributing factors

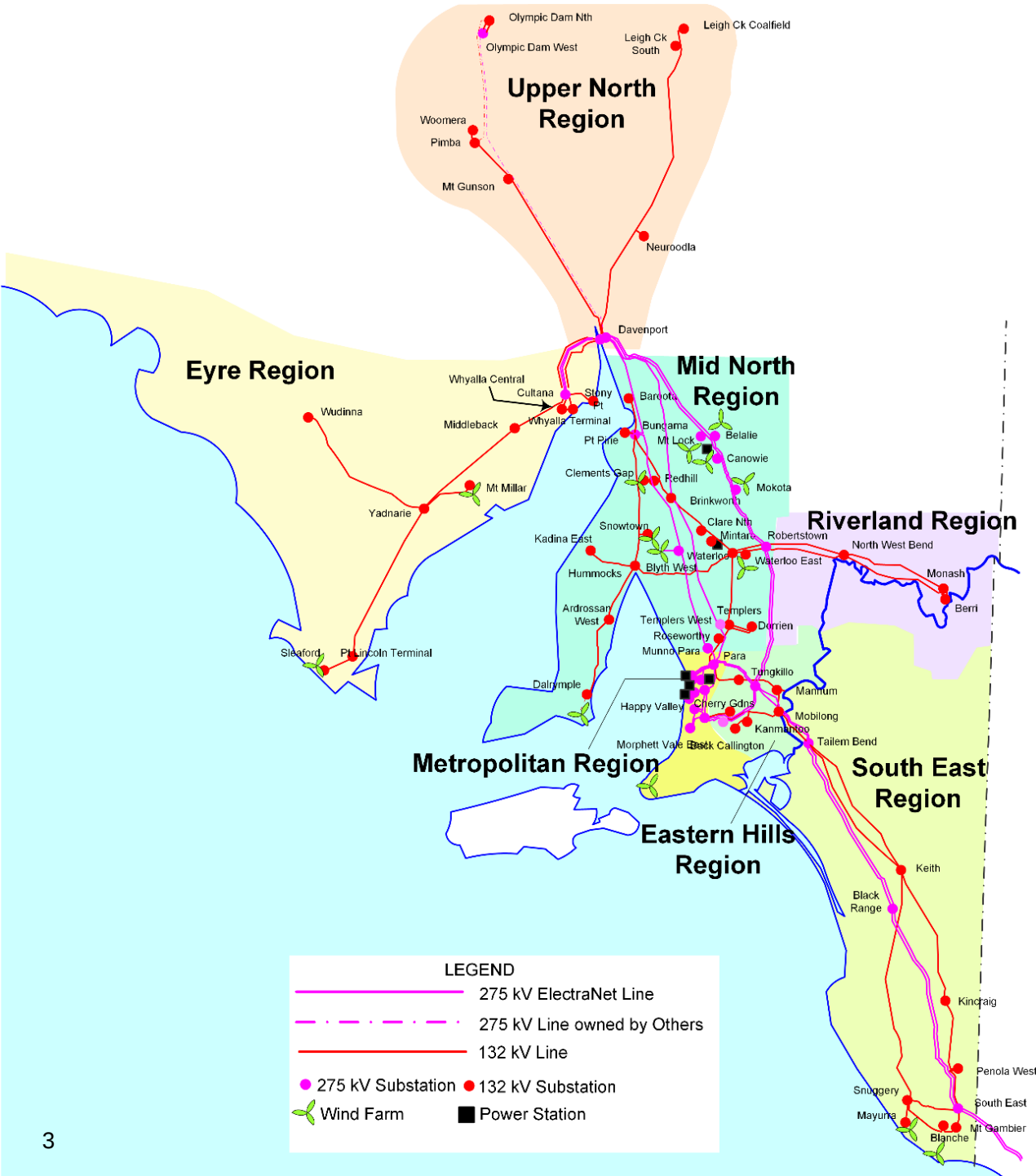
- Sequence of event
- Blackout and system restoration
- Electricity market impacts

Consequential reviews and Outcomes

- AEMO - Operating incident review
- AEMC – Mechanisms to enhance power system resilience
- Various changes to National Electricity Rules

Investing to improve resilience – NEM perspective

- SA example - SIPS
- NEM perspectives - maintaining power system resilience



Event summary

- 28 Sept 2016 severe thunderstorms and tornadoes impact widespread area of SA
- Damaged transmission lines + unexpected run-back of some wind farms → large interconnector power swing
- Exceeds stability limits and interconnector trips
- Lack of PFR in SA leads to system collapse at 16:18

Supply and market impacts

- 850000 customers lost supply ie (1826 MW)
- System restart commenced 16:30
- 80~90% of load restored by 24:00, remainder restored gradually as damaged transmission network bypassed
- Electricity market in SA suspended for 12 days
- Estimated cost \$367 million

Key outcomes from post incident reviews

AEMO – Review of incident

Reduce risk of system collapse

- Tighten generator performance standards (GPS) and compliance framework
- Set inertia requirements to control ROCOF
- Enable sufficient local PFR
- Ensure sufficient system strength
- Implement SIPS to respond increase IC flows

Effective restoration

- Maintain workable restart plans with sufficient options

AEMC – Review

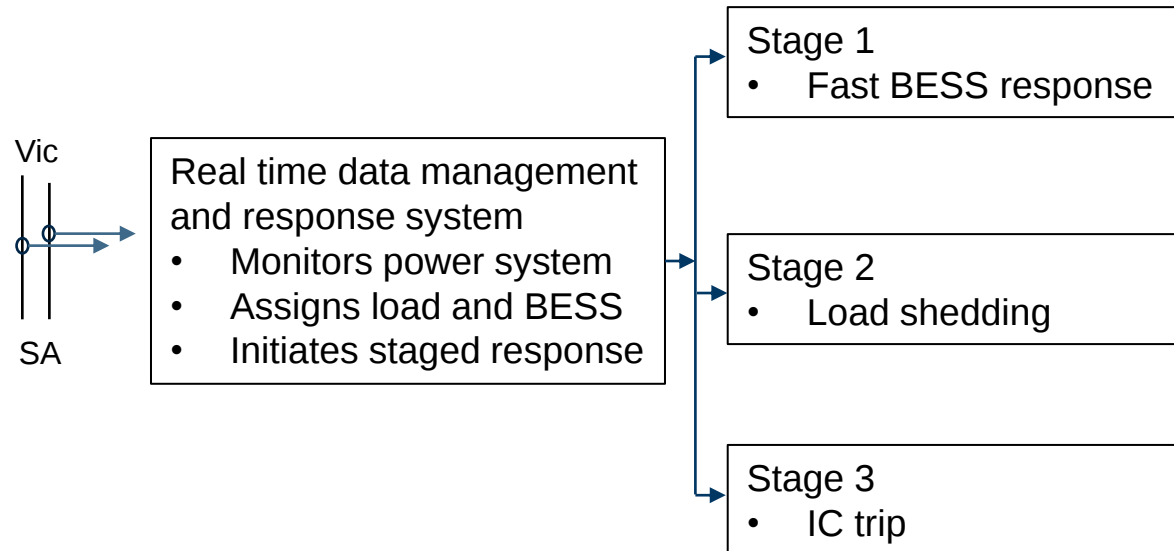
Changing risk and resilience profile:

- Need to consider indistinct events as well as contingency events
- General power system risk review needed to identify and assess emerging risks
- Protected operations framework needed to respond to abnormal conditions (eg extreme weather)
- Need to clarify obligations of participants during market suspension

Rule Changes

- Requirement for power system frequency risk review (Mar 2017)
- Protected event framework (Mar 2017)
- Revised GPS (Oct 2018)
- Framework for managing power system fault levels (Nov 2017)
- Restart plans and procedures (2018, 2020)
- Pricing during market suspension (Dec 2017)

Practical example: Protected event → SIPS enhancing SA power system resilience



The non-credible loss of multiple generating units in SA at times of high import into SA can lead to the tripping of the Heywood interconnector due to high power transfers. This non-credible event would result in rapid frequency decline, and poses a risk of cascading failures leading to a state-wide blackout.

The SIPS rapidly identifies conditions that could lead to a loss of synchronisation between SA and Vic, applying 2 stage correction:

- Stage 1 – fast response trigger to inject power from battery energy storage systems (BESS).
- Stage 2 – load shedding trigger to shed approximately 200 MW of South Australian load.
- Stage 3 – out-of-step trip scheme (islanding South Australia).

ElectraNet, in collaboration with AEMO, is enhancing the reliability of SIPS by implementing a Wide Area Protection Scheme (WAPS). The WAPS scheme uses Phasor Measurement Unit (PMU) technology to develop the enhanced scheme. ElectraNet expects the scheme to be commissioned by mid-2022.

NEM perspectives - power system resilience

Regulations to encourage routine reviews of resilience

- Reviews should consider credible, non-credible events and indistinct events and evolving power system characteristics
- Focus on events that have the greatest impact and where likelihood or consequence can be reduced through prudent investments. Informed through review of actual system events and near misses.

Use of operational tools to enhance resilience

- Use reclassification processes and protected events to cost effectively reduce the consequence of non-credible events

Plan for the inevitable widespread outage/system black event

- It is not prudent to invest to mitigate all risks → system collapse can occur
- System restart plans and processes should be regularly reviewed to ensure they remain effective
- Manage stakeholder expectations → reliability expectations aligned with investment criteria

Market considerations

- Should the market be suspended under abnormal conditions
- Decide in advance the rules for suspending the market and the criteria for returning from suspension
- Ensure that market suspension does not impede power system operation