AEMO releases final report into SA blackout, blames wind farm settings for state-wide power failure

By political reporter Nick Harmsen 28 Mar 2017, 1:01am

Updated

Photo: AEMO is working with industry to build power system resilience. (AAP: Angela Harper)

Related Story: Renewable energy mix played role in SA blackout: third report

Overly sensitive protection mechanisms in some South Australian wind farms are to blame for the catastrophic statewide blackout in September last year, the Australian Energy Market Operator (AEMO) says.

Key points:

- AEMO has released its fourth and final report into SA's September blackout
- It said overly sensitive settings in some wind farms resulted in the

statewide blackout
- But it also found the intermittent nature of wind was not to blame

In its fourth and final report into the September 29 blackout, AEMO said it was the action of a control setting responding to multiple disturbances that led to the 'black system'.

The report said the unexpected operation of the control settings resulted in the sudden loss of generation from the wind farms.

"Had the generation deficit not occurred, AEMO's modelling indicates SA would have remained connected to Victoria and the black system would have been avoided," the report said.

> *"AEMO cannot rule out the possibility that later events could have caused a black system, but is not aware of any system damage that would have done this."*

AEMO has also contradicted its own early advice that the changing nature of South Australia's electricity generation mix played no role in the blackout.

It said the generation mix now includes increased amounts of non-synchronous inverter-connected generators — in other words, wind and solar.

Big batteries, stabilisation urged for Australia's power system

South Australia's renewables-heavy power mix was a factor in the statewide blackout in September, a new report by the Australian Energy Market Operator confirms.

"This generation has different characteristics to a conventional plant, and uses active control systems, or complex software, to ride through disturbances," the report said.

"With less synchronous generation online, the system is experiencing more periods with low inertia and low available fault levels, so AEMO is working with industry on ways to use the capability of these new types of power generation to build resilience to extreme events."

AEMO said as the generation mix continues to change, it may no longer be able to rely on coal and gas generators to provide a fast enough response to stabilise the grid.

"Instead, additional means of procuring these services must be considered, from non-synchronous generators, where it is technically feasible, or from network or non-network services, such as demand response and synchronous condensers."

The Australian Energy Market Commission is already taking steps in this regard.

How the weather event tripped the system

On Wednesday September 28, two tornadoes with wind speeds between 190 and 260 kilometres per hour tore through a single-circuit 275-kilovolts transmission line and a double-circuit 275kV transmission line, about 170km apart.

The damage to these three transmission lines caused them to trip, and a sequence of faults in quick succession resulted in six voltage dips on the SA grid over a two-minute period at about 4:16pm.

As the number of faults on the transmission network grew, nine wind farms in the mid-north of SA exhibited a sustained reduction in power as a protection feature activated.

For most of them, the protection settings allowed the wind turbines to withstand a pre-set number of voltage dips within a two-minute period.

Photo: Two tornadoes with wind speeds of up to 260kph ripped down transmission lines. (ABC News: Dean Faulkner)

When the protection feature kicked in, the output of those wind farms fell by 456 megawatts over a period of less than seven seconds.

When the wind farms unexpectedly reduced their output, the Heywood Interconnector from Victoria tried to make up the shortfall.

About 700 milliseconds after the last wind farm powered down, the flow in the interconnector reached such a level that it activated a special protection scheme that tripped it offline.

The sudden loss of power flows across the interconnector sent the frequency in the SA grid plummeting.

South Australia has an automatic load-shedding system designed to kick-in in just such an event.

But the rate of change of the frequency was so rapid, the automatic load-shedding scheme did not work.

Without it, the remaining generation was much less than the connected load, and as a result, the entire system collapsed.

The SA power system then became separated from the rest of the national grid.

AEMO said its "analysis shows that following system separation, frequency collapse and the consequent black system was inevitable".

Why hasn't the entire state blacked out before?

AEMO said unforeseen separation and complete loss of the Heywood Interconnector has occurred six times in the past 17 years.

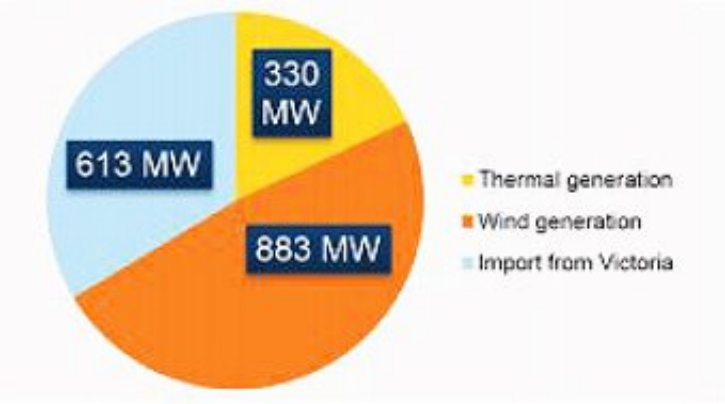

Photo: SA's generation mix before the blackout.
(Supplied: AEMO Black System SA report)

But in every other instance, the system stayed alive.

"The key differentiator between the 28 September 2016 event and the other

three events is that there was significantly lower inertia in SA in the most recent event, due to a lower number of on-line synchronous generators," the report said.

"This resulted in a substantially faster rate of change of frequency compared to the other events, exceeding the ability of the under-frequency load-shedding scheme to arrest the frequency fall before it dropped below 47Hz."

Synchronous generators include coal, gas and hydro.

The state's last coal generator, at Port Augusta, closed last year.

Some gas generators have been mothballed, or used sparingly, especially in circumstances when the state's wind and solar power output is high.

Immediately before the blackout, wind had been producing almost half of South Australia's power needs, with much of the remainder being imported from Victoria.

South Australia's thermal generators (gas and diesel) had only been outputting about 18 per cent of the state's power needs.

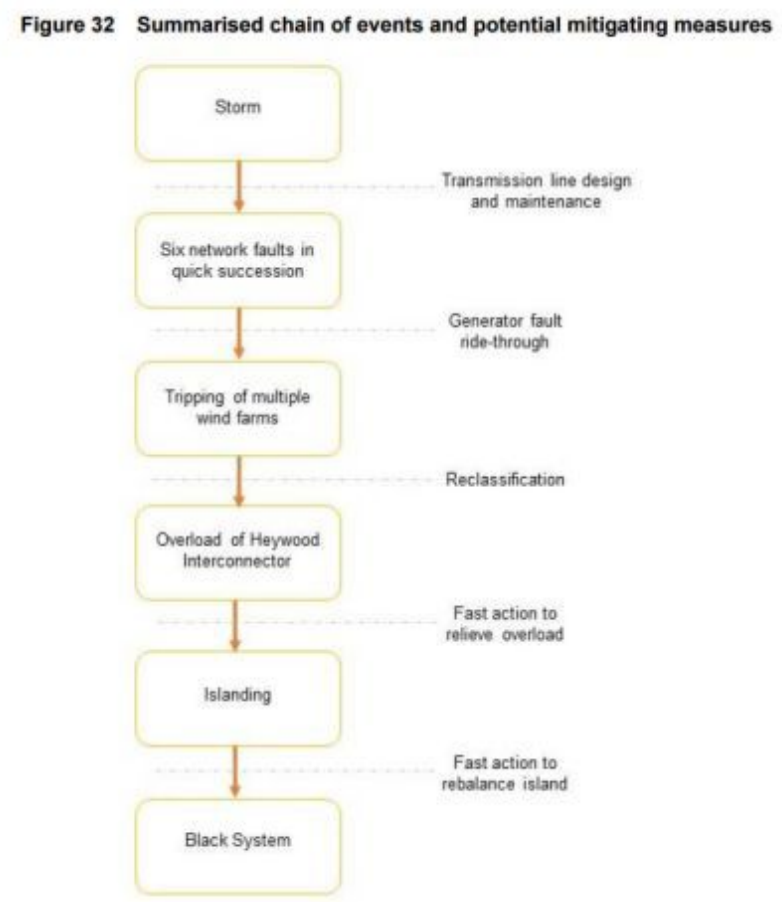

Photo: A chart showing the chain of events which led to the statewide blackout. (Supplied: AEMO)

Are wind farms to blame?

It can be argued that the changing nature of the grid, which is seeing wind farms and solar energy replacing traditional thermal generation, did make South Australia more vulnerable to a statewide blackout.

There is no doubt the protection settings on some wind farms also contributed to the chain of events which resulted in this blackout.

But AEMO also makes it clear the intermittent nature of wind was not to blame.

> *"The most well-known characteristic of wind power, variation of output with wind strength, often termed 'intermittency', was not a material factor in the events immediately prior to the black system."*

AEMO said changes made to turbine control settings shortly after the event has removed the risk of recurrence given the same number of disturbances.

Photo: SA's automatic load-shedding scheme didn't kick in during the storm. (AAP: David Mariuz)

More on this story:

- Renewable energy mix played role in SA blackout: third report
- Wind farms lost power due to safety settings during SA blackout
- Australia's power grid in need of multi-billion-dollar upgrade: report
- Unclear if wind power played role in SA blackout, report says
- South Australian blackouts a case of history repeating itself
- Gas, solar mix could reduce SA's reliance on national power

Topics: alternative-energy, environment, electricity-energy-and-utilities, industry, states-and-territories, federal---state-issues, government-and-politics, sa, adelaide-5000

First posted 27 Mar 2017, 7:46pm