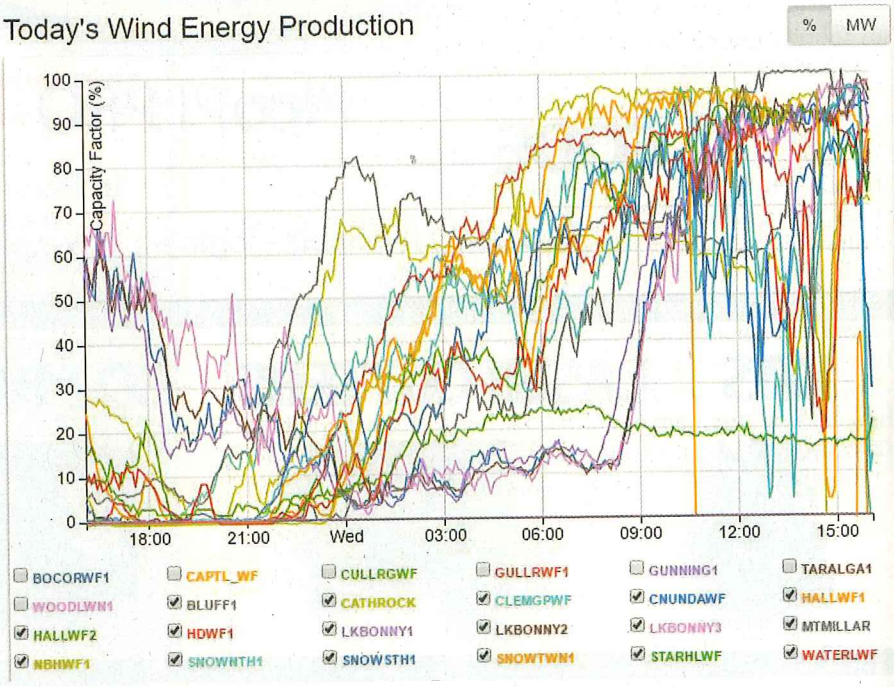
So for a 5% capacitor mismatch (C_1=1.05 times C_2), the voltage error is much less at 0.4%. Likewise, if the mismatch is 100% (C_1=2 times C_2), the error is 6%.

Ken Moxham,
Urrbrae, SA.

Wind power loss did cause South Australian blackout

Congratulations to Leo Simpson, (Publisher's Letter, November 2016), for his incisive analysis and statement of the consequences – the damage to the Australian economy, the ongoing train wreck that is the South Australian economy – of the state-wide blackout in South Australia on 28th September this year. The cause, for the grid collapse to propagate state-wide so quickly, was the sudden loss of some 315MW of wind generation in a 6-second interval, from 16:18:09 on 28th September (source: AEMO Preliminary Report - Black System Event in South Australia on 28 September 2016, page 2), available at www.aemo.com.au/Media-Centre/-/media/BE174B1732CB-4B3ABB74BD507664B270.ashx

Predictably, there has been much finger-pointing, particularly by the renewables lobby, at the collapse of a number of key transmission lines during the severe weather event experienced across South Australia on the day. However, the fact remains that it takes much more than the few "system disturbances", that allegedly took out the wind farms, to take out conventional synchronous generation. In fact, a key statement of the AEMO



Mailbag: continued

No need for a religious crusade against renewable energy

I always read the Publisher's Letter with interest whether it's on a technical topic or a flamboyant expression of opinion guaranteed to excite debate. May I join the flood of responses to the November 2016 editorial on the South Australian power blackout? I suspect this was written well in advance of the facts being known.

In fact the transmission line failures preceded the wind turbine shutdown. That radical greenie publication the Australian Financial Review reports the head of energy for Siemens Australia as saying, "The wind farms tripped off because of their proximity to the faults." "Whether it is coal-fired power or gas-fired power, either would be similar, and coal-fired power or gas-fired power are even more sensitive to low voltage or frequency faults than wind turbines." See www.afr.com/news/gas-plant-close-to-fault-would-switch-off-just-like-wind-siemens-20161019-gs6atu

There are many lessons to be learnt from the SA blackout, but a "religious crusade" against renewable energy is not one of them.

P.S. My mozzie lure from the October 2016 issue (night-time version) has yet to catch anything. I'm interested in other readers' results.

Peter Reed,
Fullarton, SA.

Mailbag: continued

report is that, up until the loss of the Heywood interconnector, the State's synchronous thermal generation that was operational at the time continued to operate right up until the point of system collapse.

The role of the "system inertia", an inherent property of synchronous generation but absent in non-synchronous generation, such as wind farms and solar PV equipment, in enabling the riding out of the transients caused by system faults seems to be poorly understood by people other than power systems engineers.

Conventional generators, whether steam or gas turbine, diesel or hydro-powered can only be connected to the grid when their generator rotors spin at precisely what is called "synchronous speed". For a system frequency of 50Hz, as in Australia, the rotational speed of 2-pole alternator is 1500 RPM; for a 4-pole alternator, the synchronous speed is 750 RPM etc.

All conventional generators connected to a grid are spinning, in phase, at synchronous speed, actually providing the system frequency of 50Hz. The mechanical inertia of this collected rotation provides the "system inertia" of the grid.

It is the stored energy in this mechanical inertia that enables conventional generation to ride through system disturbances for periods that are long enough to change throttle settings, disconnect faulted lines etc, so as to deal with such disturbances as lightning strikes, transmission line faults, dropouts of large loads, and even failed generators. For a more complete explanation of the role of synchronous inertia, see, for example, Gannon, M. 2014 "Emerging Rate-of-Change-of-Frequency Problem in the NEM: Best-practice Regulatory Analysis of Options". Available at: **www.farrierswier.com.au/wp-content/uploads/2014/11/Best_practice_regulatory_analysis_of_emerging_RoCoF_problem_in_the_NEM_FSC.pdf**

In the days before the market distortion caused by renewables, the grid controller would ensure that all available thermal generation was powered up, in hot spinning reserve, so that in the event of system disturbances it was instantly available, ready to ride these disturbances out. In particular, all thermal generation near population centres would be fired up, ready to protect the grid in those regions.

In South Australia, there are two major power stations located within 20km of Adelaide: the 1280MW Torrens Island gas-fired steam plant and the 480MW Pelican Point state-of-the-art Combined Cycle Gas Turbine (CCGT) power station. One would have expected these to be fully operational in the lead-up to the onset of bad weather on the day. It is interesting to look at the state of preparedness in South Australia on September 28th last. From an analysis of the publicly-available AEMO data for Wednesday September 28th, two things stand out:

1. Some 600MW, comprising three 200MW generators, only, of the 1280MW capacity of the Torrens Island plant was actually operational. These generators were operating only at part-load, the balance of the requirement above that being supplied by wind generation and the Heywood interconnector from Victoria. One can only presume that this strategy was adopted because the power being sup-

plied via Heywood was cheaper than that from Torrens Island running on expensive gas.

2. The 480MW Pelican Point power station was powered off soon after midnight on the 27/28th and was non-operational right throughout the day, including the system collapse event, restarting only after about 10pm that evening.

3. The wind farms, particularly those in the mid-North of South Australia, were individually switching out and in, presumably shutting down in response to excessive local wind speeds, then restarting, with the result that their output was gyrating up and down through the course of the afternoon for some hours prior to the actual failure event. These power swings are a grid controller's nightmare.

It is clear that there was far less local synchronous generation than that being supplied by wind generation. The AEMO 5-minute data shows that when the critical loss of 315MW of wind generation occurred, both the Heywood interconnector and the operational local generation instantly responded, but clearly from the outcome, there simply was not enough generation available to make up that particular loss, particularly once the Heywood interconnector, which was supplying the bulk of the remaining power, tripped out.

For a more detailed analysis, the reader is referred to: www.onlineopinion.com.au/view.asp?article=18577&page=0

The accompanying plot of windfarm output before the blackout shows the large variations which occurred. It must be obvious now that having a large proportion of wind power in any grid is a formula for instability and ultimately, more state-wide blackouts.

There is of course no guarantee that there might have been a more favourable outcome, but South Australia would have been in a much better state of preparedness had the rest of the Torrens Island plant and that at Pelican Point been operational. Also, a major contributing factor to the blackout going Statewide was the closure of the 546MW Northern Power Station at Port Augusta in April.

Indeed, it simply beggars belief that the South Australian government permitted its closure. With the failure of the wind farms in the mid-North of the State and the loss of key transmission lines there, the entire northern region was effectively isolated. Had Northern still been operational, it is likely that the severe damage to both the Whyalla steelworks and the Port Pirie smelter might have at least been mitigated. Also, Port Lincoln might not have been without power for a week.

It beggars belief even more that the SA government would allow both the Torrens Island and Pelican Point power stations to be scheduled for closure in 2017, yet that was another proud boast some months ago. One can only hope that this recent event will bring sanity to bear.

It is also time that governments in Australia realised that messing with electricity grids is fraught with extreme risk. It is time they abolished the MRET subsidy scheme, as it is now clear that supporting intermittent renewable generation is a completely futile means of seeking to reduce CO_2 emissions.

Paul Miskelly,
Mittagong, NSW.

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