

## Electricity Pricing Event Report – Tuesday 06 September 2016 to Saturday 10 September 2016

**Market Outcomes:** South Australia Raise Regulation Frequency Control Ancillary Service (FCAS) prices ranged between \$98/MWh and \$452.66/MWh for all trading intervals (TIs) between TI ending 0730 hrs on 6 September 2016 and 1800 hrs on 10 September 2016. South Australian Lower Regulation FCAS prices ranged between \$77.50/MWh and \$300/MWh for 196 TIs over the same period (total of 214 TIs).

South Australia had a high energy price of \$1,783.47/MWh for TI ending 2100 hrs on 8 September 2016 and a negative energy price of -\$144.15/MWh for TI ending 1500 hrs on 9 September 2016.

FCAS and Energy prices in the other regions were not affected by this event.

Actual Lack of Reserve Level 2 (LOR2) conditions had been declared for the South Australia region between:

- 0710 hrs on 6 September 2016 and 2300 hrs on 7 September 2016 (Market Notices 54853 and 54860).
- 0220 hrs on 8 September 2016 and 0535 hrs on 9 September 2016 (Market Notices 54861 and 54880).
- 0710 hrs and 0945 hrs on 9 September 2016 (Market Notices 54882 and 54883).
- 1800 hrs on 9 September 2016 and 1805 hrs on 10 September 2016 (Market Notices 54886 and 54889).

During these LOR2 periods, there were sufficient capacity reserves in the South Australia region to meet electricity demand. However in the event of a credible contingency, whereby South Australia separated from the rest of the NEM, power interruptions would have been likely as it may not have been possible to bring the required additional capacity into service in time to avoid automatic under-frequency load shedding.

At 1635 hrs on 1 September 2016, the rolling sum of Raise Regulation FCAS price for the South Australia region for the previous 2,016 dispatch intervals (DIs) exceeded six times the cumulative price threshold (CPT) of \$210,100. As a result, an administered price cap (APC) of \$300/MWh was applied to all ancillary service prices in South Australia for DIs ending between 1640 hrs on 01 September 2016 and 0400 hrs on 09 September 2016 (Market Notices 54827 and 54877).

**Detailed Analysis:** The 5-minute Raise Regulation FCAS price ranged between \$98/MWh and \$1,100.95/MWh for all DIs between DIs ending 0705 hrs on 6 September 2016 and 1800 hrs on 10 September 2016 (total of 1,284 DIs). The 5-minute Lower Regulation FCAS price ranged between \$128.69/MWh and \$565.35/MWh for 1,153 DIs over the same period. These high FCAS prices are mainly attributed to the application of local Regulation FCAS requirements within South Australia during a planned outage of the Heywood No. 2 500 kV Bus. Other contributing factors include shifting and withdrawal of generation capacity and limitations associated with available Regulation FCAS during some DIs.

The 5-minute Energy dispatch price reached the Market Price Cap (MPC) of \$14,000/MWh for DI ending 2035 hrs on 8 September 2016. This high energy price was mainly attributed to a sudden reduction in wind generation and limited interconnector support, during a planned network outage.

The 5-minute Energy dispatch price was -\$592.10/MWh for DI ending 1500 hrs on 9 September 2016. This negative energy price was mainly attributed to high wind generation, a decrease in demand and limited interconnector flows, during a planned network outage.

The Heywood No. 2 500 kV Bus was on a planned outage between 0713 hrs on 6 September 2016 and 1733 hrs on 10 September. The outage constraint sets F-I\_HYSE, S-BOTH\_BLKRG\_C\_OS, V-HYTX\_M12 and V-HY\_500BUS were invoked for the duration of this outage. The Heywood – Mortlake 500kV line was also on a planned outage between 0740 hrs and 1643 hrs on 6 September 2016 and between 0734 hrs and 1655 hrs on 7 September 2016. The outage constraint sets F-V-HYMO, S-X\_BC\_CP and V-HYMO were invoked for the duration of this outage on each day. These outages increased the risk of synchronous separation between South Australia and Victoria. The constraint equations F\_S+LREG\_0035 and F\_S+RREG\_0035 contained within the F-V-HYMO and F-I\_HYSE constraint sets required 35 MW of Lower and Raise Regulation FCAS capacity to be sourced from within South Australia.

Regulation FCAS in South Australia during the outage period was provided by Torrens Island B PS, Quarantine PS unit 5 (QPS5), Pelican Point PS and Osborne PS.

### **06 September 2016**

Following the commencement of the Heywood No. 2 500 kV Bus outage, between DIs ending 0715 hrs on 6 September and 0000 hrs on 7 September, the 5-minute Regulation FCAS prices ranged between \$20/MWh and \$287/MWh. The 5-minute Regulation FCAS prices reached up to \$287/MWh for DIs ending 1345 hrs, 1350 hrs, 1355 hrs, 1805 hrs and 1925 hrs, when the output from at least one unit providing Regulation services exceeded its Regulation FCAS trapezium maximum enablement limit. Consequently, these units became stranded or trapped (unavailable) for Regulation FCAS and additional generation had to be enabled from more expensive price bands.

For 6 September, South Australia 30-minute energy prices ranged between \$22.60/MWh and \$146.61/MWh.

### **07 September 2016**

Between DIs ending 0035 hrs and 0700 hrs, the 5-minute Regulation FCAS prices were elevated between \$285/MWh and \$300/MWh, when Pelican Point withdrew 35 MW of generation capacity from both the Regulation markets and AGL shifted 4 MW of Regulation capacity from \$286.60/MWh to \$13,780.70/MWh.<sup>1</sup>

The elevated prices reduced to \$98/MWh or below between DIs ending 0705 hrs and 0800 hrs, when additional Regulation capacity was made available from Torrens Island B PS. From DI ending 0805 hrs on 7 September until 0000 hrs on 8 September 2016, the Regulation prices returned to elevated levels ranging between \$284/MWh and \$300/MWh when AGL withdrew all generation capacity from Torrens Island B unit 4.

For 7 September, South Australia 30-minute energy prices were typical, mostly ranging between \$5.96/MWh and \$46.51/MWh. However, for 6 TIs, prices dropped to between -\$6.16/MWh and -\$73.10/MWh, as there was no generation offered between -\$45/MWh and \$0/MWh, so small fluctuations in wind or demand led to negative prices for some DIs.

### **08 September 2016**

5-minute Regulation FCAS prices continued to remain elevated between \$284/MWh and \$300/MWh between DIs ending 0005 hrs and 1535 hrs. The Regulation FCAS prices reduced to \$98/MWh or below between DIs ending 1540 hrs and 1600 hrs, when additional Regulation capacity became available

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<sup>1</sup> 4 MW of Torrens Island PS units 3 and 4 Lower and Raise Regulation FCAS capacity was shifted from lower to higher priced bands at 0005 hrs and 0035 hrs, respectively.

from Torrens Island B PS. The Regulation FCAS prices returned to \$129/MWh or above between DIs ending 1605 hrs on 8 September and 0000 hrs on 9 September, when AGL shifted 12 MW of Raise and Lower Regulation capacity from bands priced at \$299.57/MWh or below to \$13,980.43/MWh.

The 5-minute energy price in South Australia reached \$14,000/MWh for DI ending 2035 hrs. Between DIs ending 2030 hrs and 2035 hrs, wind generation decreased by 75 MW in South Australia, reaching 697 MW at DI ending 2035 hrs. Consequently, additional generation had to be sourced from Osborne PS and Torrens Island B PS at more expensive price bands. The increased dispatch in the Energy market reduced Osborne PS availability in the Raise Regulation FCAS market to zero. For DI ending 2035 hrs, the F\_S+RREG\_0035 constraint equation violated as only 26.84 MW of Raise Regulation capacity was available in South Australia, below the 35 MW required by the constraint equation. For DI ending 2035 hrs, the Raise Regulation FCAS price was capped to the APC of \$300/MWh.

For DI ending 2035 hrs, the target flow towards South Australia on the Heywood and Murraylink interconnectors was limited to 189 MW and 220 MW, respectively.<sup>2,3</sup> Cheaper priced generation was available but required more than one DI to synchronise (Ladbroke Grove GT units 1 and 2).

### **09 September 2016**

The APC was removed at 0400 hrs on 09 September 2016 when the cumulative sum of Lower and Raise Regulation FCAS prices reduced to below six times the CPT.

For DI ending 0405 hrs, the Regulation FCAS prices reduced from \$285/MWh or above to \$128.69/MWh, when additional lower priced capacity became available from Torrens Island B PS and Pelican Point PS. Regulation FCAS prices ranged between \$128.69/MWh and \$191.73/MWh for all DIs throughout the day, except DIs ending 1105 hrs, 1500 hrs, 2305 hrs and 2310 hrs.

For DI ending 1105 hrs, the Regulation FCAS prices increased up to \$324.80/MWh, when Torrens Island B unit 3 was unavailable to provide Regulation FCAS (AGC status off). For DI ending 1500 hrs, the 5-minute Lower Regulation FCAS prices increased up to \$565.35/MWh, when Pelican Point's availability in the Lower Regulation FCAS market decreased.

The 5-minute Regulation FCAS prices increased up to \$1,100.95/MWh for DIs ending 2305 hrs and 2310 hrs, when Torrens Island B PS availability in Regulation FCAS markets reduced due to increased dispatch in the energy market.

The 5-minute energy price was negative for 36 DIs between DIs ending 1230 hrs and 1605 hrs. The prices reduced up to -\$592.10/MWh for DI ending 1500 hrs. During this period, wind generation was high, reaching up to 1,049 MW, and demand reducing, reaching a minimum of 1,069 MW.

For DI ending 1500 hrs, the target flow towards Victoria on the Murraylink interconnector was limited to 56 MW by the FCAS constraint equation F\_S++HYSE\_L60.<sup>4</sup> The target flow towards Victoria on the Heywood interconnector was limited to 175 MW by the thermal constraint equation S>V\_NIL\_NIL\_RBNW.<sup>5</sup> With excess lower priced generation available in South Australia during the low demand period, the South Australia price decreased to -\$592.10/MWh for DI ending 1500 hrs.

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<sup>2</sup> Heywood was limited by the V\_S\_ROCOF constraint equation, which prevents the cascading loss of generation in South Australia following a separation event, during a period when South Australia is at risk of separation from Victoria.

<sup>3</sup> Murraylink was limited by the upper transfer limit constraint equation VSML\_220.

<sup>4</sup> This constraint equation manages the Slow Lower FCAS requirement in South Australia, during the outage of the Heywood No. 2 500 kV Bus.

<sup>5</sup> The system normal constraint equation, S>V\_NIL\_NIL\_RBNW, prevents the overload of Robertstown – North West Bend No.1 or 2 132kV lines.

## **10 September 2016**

The 5-minute Regulation FCAS prices was \$128.69/MWh for most DIs between DIs ending 0005 hrs and 1805 hrs. Between DIs ending 0205 hrs and 0400 hrs, Lower Regulation prices ranged between \$292.33/MWh and \$295.42/MWh, as the availability of Lower Regulation services from Torrens Island PS units 1, 3 and 4 was limited for those DIs.

For DI ending 1810 hrs, the 5-minute Raise and Lower Regulation prices reduced to \$16.12/MWh and \$3/MWh, respectively, when the outage constraint set F-I-HYSE was revoked following completion of the Heywood No. 2 500 kV Bus outage and there was no longer a local Regulation FCAS requirement for SA.

The high Regulation FCAS prices were generally forecast in pre-dispatch schedules. The high energy price on 8 September was not forecast in pre-dispatch schedules, as it was the result of a decrease in wind generation within the affected TI. The negative energy price on 9 September 2016 was not forecast in pre-dispatch as forecast demand was higher in the latest pre-dispatch schedule, compared to dispatch.

