

## Electricity Pricing Event Report – Tuesday 18 October 2016 to Saturday 22 October 2016

**Market Outcomes:** South Australia Raise Regulation Frequency Control Ancillary Service (FCAS) prices ranged between \$74.69/MWh and \$13,083.33/MWh for all trading intervals (TIs) between TI ending 0730 hrs on 18 October 2016 and 1100 hrs on 22 October 2016. South Australian Lower Regulation FCAS prices ranged between \$74.69/MWh and \$12,306/MWh for all TIs over the same period.

South Australia had Negative energy prices of -\$195.81/MWh and -\$145.03/MWh for TIs ending 1200 hrs and 1530 hrs, respectively, on 18 October 2016. High energy prices of \$2,474.13/MWh and \$2,377.53/MWh were also observed for TIs ending 0700 hrs and 1600 hrs, respectively, on 19 October 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:

- 0840 hrs and 1030 hrs on 18 October 2016 (Market Notices 55407 and 55409).
- 1745 hrs on 18 October 2016 and 0610 hrs on 20 October 2016 (Market Notices 55418 and 55434).
- 2050 hrs on 20 October 2016 and 1050 hrs on 22 October 2016 (Market Notices 55445 and 55457).

During these LOR2 periods, there were sufficient capacity reserves in the South Australia region to meet electricity demand. However the planned outage of Heywood – South East No.2 275 kV line meant that a credible contingency could result in South Australia being separated from Victoria, which could in-turn trigger automatic under-frequency load shedding, and result in power interruptions.

**Detailed Analysis:** The 5-minute Raise Regulation FCAS price ranged between \$74.69/MWh and \$14,000/MWh for all DIs between DIs ending 0705 hrs on 18 October 2016 and 1050 hrs on 22 October 2016 (total of 1,198 DIs). The 5-minute Lower Regulation FCAS price ranged between \$74.69/MWh and \$13,799.99/MWh for all DIs over the same period. The high FCAS prices are mainly attributed to the application of local Regulation FCAS requirements within South Australia during a planned outage of the Heywood – South East No.2 275 kV line. Other contributing factors included limitations associated with available Regulation FCAS during some DIs.

The Heywood – South East No.2 275 kV line was on a planned outage between 0712 hrs on 18 October 2016 and 1015 hrs on 22 October. This outage increased the risk of electrical separation between South Australia and Victoria. The outage constraint sets F-I-HYSE, S-X\_BC\_CP, V-HYTX\_M12 and I-HYSE were invoked for the duration of this outage. The invoked constraint sets limited flow from Victoria to South Australia on the Heywood interconnector to an upper limit of 250 MW. The constraint equations F\_S+LREG\_0035 and F\_S+RREG\_0035 contained within the F-I\_HYSE constraint sets required 35 MW of Lower and Raise Regulation FCAS capacity to be sourced from within South Australia.

The 5-minute Energy price reduced to the Market Floor Price (MFP) of -\$1,000/MWh for DI ending 1150 hrs on 18 October 2016. This negative energy price was mainly attributed to an increase in wind generation and limited interconnector flows, during the planned network outage.

The 5-minute Energy price reduced to MFP for DI ending 1505 hrs on 18 October 2016. This negative energy price was mainly attributed to a decrease in demand and limited interconnector flows, during a planned network outage.

The 5-minute Energy price was \$13,998.99/MWh for DI ending 0640 hrs on 19 October 2016. This high energy price was mainly attributed to low wind generation during the morning peak demand period, and limited interconnector support during the planned network outage.

The 5-minute Energy price reached the Market Price Cap (MPC) of \$14,000 /MWh for DI ending 1550 hrs on 19 October 2016. This high energy price was attributed to an incorrect SCADA input into the V>S\_NIL\_HYSE system normal constraint equation. This thermal constraint avoids overloading either of the Heywood – South East 275 kV lines for the trip of parallel line. The incorrect input indicated a flow of 828 MVA on the Heywood – South East No.2 275 kV line which was on planned outage. This caused the V>S\_NIL\_HYSE constraint equation to violate, reversing flow on the remaining Heywood – South East No.1 275 kV line from 250 MW towards South Australia to 23 MW towards Victoria.

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

### **18 October 2016**

**Regulation FCAS prices:** Following the commencement of the Heywood – South East No.2 275 kV line outage, between DI ending 0705 hrs and 0820 hrs on 18 October 2016, the 5-minute Regulation FCAS prices ranged between \$11,000/MWh and \$11,499.99/MWh. The 5-min Regulation FCAS price reduced from DI ending 0825 hrs when Pelican Point became available to provide Regulation FCAS services. The prices ranged between \$74.69/MWh and \$145.50/MWh for most DIs until DI ending 1900 hrs.

For DI ending 1905 hrs, the Raise and Lower Regulation FCAS price reached \$12,899.99/MWh and \$12,010.80/MWh, respectively, when Quarantine PS unit 5 was unable to provide Regulation FCAS services and its energy output reduced to 0 MW. For the next DI ending 1910 hrs, Quarantine PS unit 5 withdrew all availability (122 MW) from the energy market with the reason “1858P CHANGE IN AVAIL - GAS VALVE TRIP – SL”. The 5-min Regulation FCAS prices ranged between \$12,000/MWh and \$14,000/MWh between DI ending 1905 hrs and 2245 hrs. For DI ending 2220 hrs, Quarantine PS rebid its availability (122 MW) back into the energy market, however its Fast Start Profile limited it from providing Regulation FCAS services until DI ending 2250 hrs. Regulation FCAS prices ranged between \$74.69/MWh and \$1,057.87/MWh for most DIs between DI ending 2250 hrs on 18 October 2016 and 0000 hrs on 19 October 2016.

For DI ending 2330 hrs, Torrens Island B unit 4 output was 195.25 MW, which was above the unit’s Regulation FCAS maximum enablement limit of 195 MW. As a result the unit became unavailable (stranded) for Regulation FCAS and the Raise and Lower Regulation FCAS prices in SA increased to \$12,899.99/MWh and \$12,896.69/MWh, respectively.

**Energy prices:** For DI ending 1150 hrs, the negative energy price of -\$1,000/MWh can be attributed to an increase in wind generation of 150 MW between DIs ending 1145 hrs and 1150 hrs. Demand in SA was 1354 MW for TI ending 1200 hrs, and wind generation was 1091 MW for the same TI. Interconnector export to Victoria was also limited. The export was limited to 175 MW on Murraylink by the system normal thermal constraint equation S>V\_NIL\_NIL\_RBNW and to 75 MW on the Heywood interconnector by the FCAS constraint equation F\_S++HYSE\_L60 which was invoked during the planned outage. During this DI the Fast Lower and Lower Regulation FCAS price was \$846.82/MWh and \$601.77/MWh, respectively.

For DI ending 1505 hrs, the negative energy price of -\$1,000/MWh can be attributed to a reduction in demand of 79 MW between DI ending 1500 hrs and 1505 hrs. Export to Victoria was limited to 176 MW on Murraylink by the S>V\_NIL\_NIL\_RBNW constraint equation and to 74 MW on the Heywood interconnector by the outage FCAS constraint equation F\_++HYSE\_L6\_1. During DI ending 1505 hrs, the Fast Lower and Lower Regulation FCAS price was \$860.58/MWh and \$568.88/MWh, respectively.

During all other trading intervals, the South Australia 30-minute energy prices ranged between - \$50.63/MWh and \$110.43/MWh for all TIs.

## **19 October 2016**

**Regulation FCAS prices:** 5-minute Regulation FCAS prices ranged between \$74.69/MWh and \$493.81/MWh for most DIs on 19 October 2016. For DI ending 0620 hrs, Raise and Lower Regulation FCAS prices reached \$11,500.28/MWh and \$11,000/MWh, respectively, when Pelican Point PS was stranded and unavailable to provide Regulation FCAS services. For this DI, Pelican Point PS energy output of 243.72 MW exceeded its Regulation FCAS enablement maximum limit of 235 MW.

For DI ending 0650 hrs, the 5-minute Raise and Lower Regulation FCAS price reached \$12,585.34/MWh and \$11,000/MWh when Pelican Point PS was unavailable to provide Regulation FCAS services. For this DI, Pelican Point PS output was 202.08 MW, below its Regulation FCAS enablement minimum of 203.34 MW. Regulation FCAS prices ranged between \$74.69/MWh and \$1,111.60/MWh for most DIs between DI ending 0655 hrs on 19 October 2016 and 0000 hrs on 20 October 2016.

**Energy prices:** For DI ending 0640 hrs, the 5-minute energy price reached \$13,998.99/MWh and the Raise Regulation FCAS price was \$13,913.99/MWh. The high energy price was a result of low wind generation in the region (47 MW) during the morning peak demand period. Target flow on the Heywood interconnector towards South Australia was limited to 250 MW by the dynamic transfer limit constraint equation VS\_250\_DYN. Target flow on Murraylink interconnector towards South Australia was limited to 183 MW by the thermal constraint equation V^SML\_NSWRB\_2. This constraint equation prevents voltage collapse in Victoria for the loss of the Darlington Point – Buronga (X5) 220kV line. The high Raise Regulation FCAS price was due to limited availability of lower priced Regulation capacity in SA during this DI.

For DI ending 1550 hrs, the 5-minute energy price reached the MPC and Raise Regulation FCAS price reached \$12,899.99/MWh. The high energy price can be attributed to an incorrect SCADA input into the V>S\_NIL\_HYSE constraint equation. This caused the V>S\_NIL\_HYSE constraint equation to violate, reversing flow on the remaining Heywood – South East No.1 275 kV line from 250 MW towards South Australia to 23 MW towards Victoria. This resulted in increased dispatch of lower priced Regulation FCAS providers in the Energy market, resulting in insufficient availability of Raise Regulation FCAS capacity to meet the 35 MW requirement and the constraint equation F\_S+RREG\_0035 to violate. Raise Regulation FCAS prices remained elevated until DI ending 1605 hrs.

For the remaining TIs on 19 October, South Australia 30-minute energy prices were typical, mostly ranging between \$34.80/MWh and \$365.20/MWh.

## **20 October 2016**

5-minute Raise Regulation FCAS prices continued to remain at \$74.69/MWh for most DIs between DI ending 0005 hrs on 20 October and 0000 hrs on 21 October. For DIs ending 2335 hrs and 2340 hrs, the Raise Regulation FCAS prices were elevated, reaching \$399.99/MWh and \$1039.58/MWh, respectively. During these DIs, a number of generators providing Raise Regulation FCAS services were dispatched higher in the Energy market due to the hot water load pick-up. This reduced the Raise Regulation FCAS availability of these generators, and more expensive Raise Regulation FCAS capacity had to be procured to meet the 35 MW requirement.

5-minute Lower Regulation FCAS prices remained between \$74.69/MWh and \$425/MWh for all DIs between DI ending 0005 hrs on 20 October and 0000 hrs on 21 October. Higher priced DIs were attributed to periods with insufficient cheaper priced Lower Regulation FCAS capacity.

For 20 October, South Australia 30-minute energy prices ranged between -\$66.69/MWh and \$104.93/MWh.

### **21 October 2016**

5-minute Raise Regulation FCAS prices remained between \$74.69/MWh and \$370.56/MWh and the Lower Regulation FCAS prices remained between \$74.69/MWh and \$449.20/MWh for all DIs between DI ending 0005 hrs on 21 October and 0000 hrs on 22 October 2016, except for DI ending 0815 hrs. For DI ending 0815 hrs, the Raise and Lower Regulation FCAS prices reached \$14,000/MWh and \$13,799.99/MWh, respectively, when Torrens Island B PS unit 4 became unavailable (stranded) to provide Regulation FCAS services. For this DI, Torrens Island B unit 4 energy output of 195.8 MW exceeded its Regulation FCAS enablement maximum limit of 195 MW.

For 21 October, South Australia 30-minute energy prices ranged between -\$57.01/MWh and \$85.56/MWh.

### **22 October 2016**

The 5-minute Regulation FCAS prices remained between \$74.69/MWh and \$379.69/MWh for all DIs between DI ending 0005 hrs and 1050 hrs on 22 October 2016. During this period, DIs with elevated FCAS prices were mainly attributed to reduced lower priced Regulation FCAS availability due to a number of generators providing these services being dispatched higher in the Energy market. During this period, the 30-min energy price in South Australia ranged between \$11.72/MWh and \$82.21/MWh.

For DI ending 1055 hrs, the 5-minute Raise and Lower Regulation prices reduced to \$7.4/MWh and \$9/MWh, respectively, when the outage constraint set F-I-HYSE was revoked following completion of the Heywood – South East No.2 275 kV line outage and there was no longer a local Regulation FCAS requirement for SA.

The high Regulation FCAS prices were forecast in all pre-dispatch schedules from 1300 hrs on 17 October 2016.

