



# Electricity Pricing Event Reports

AUGUST 2016

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*\* A summary was prepared as the maximum daily spot price was between \$500/MWh and \$2,000/MWh*



## Monday 01 August 2016 – High Energy price SA

**Market Outcomes:** Spot price in South Australia reached \$4,772.49/MWh for trading interval (TI) ending 0930 hrs.

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

**Detailed Analysis:** The 5-Minute dispatch price in South Australia reached \$13,998.99/MWh for dispatch intervals (DIs) ending 0910 hrs and 0915 hrs. These high prices can be mainly attributed to planned network outages, a reduction in availability of lower priced generation, limited interconnector support and tight supply in South Australia, during the morning peak demand period.

Planned outage of the Penola West – South East 132 kV line was scheduled between 0809 hrs and 1004 hrs on 1 August 2016. Outage constraint set S-PWSE\_2 was invoked for the duration for the outage.

Demand reached the morning peak of 1,738 MW at DI ending 0900 hrs. For the high priced DIs, ending 0910 hrs and 0915 hrs, demand was 1,732 MW and 1,733 MW, respectively. Wind generation in South Australia was 339 MW and 325 MW, respectively, for the same DIs.

A number of generating units were unavailable during the day, including Torrens Island A units 1, 3 and 4 (total maximum capacity of 360 MW), Torrens Island B unit 2 (maximum capacity 210 MW) and Pelican Point CCGT (maximum capacity 510 MW, however up to 235 MW was available over July 2016). Additionally, Torrens Island B unit 3 had only 14 MW available (generally 200 MW available). For the high priced DIs, the majority of available South Australian units were generating at or close to their maximum availability.

Between DIs ending 0905 hrs and 0910 hrs, wind generation in South Australia decreased by 44 MW, from 383 MW to 339 MW.

For DI ending 0910 hrs, the target flow towards South Australia on the Heywood interconnector was at 365 MW, which violated the limit of 364.74 MW set by the transient stability constraint equation V::S\_NIL\_TBSE\_2. This constraint equation prevents transient instability across the VIC – SA cut-set for the loss of one of the Tailem Bend – South East 275 kV lines (both Black Range series capacitors unavailable). For DI ending 0910 hrs, the target flow towards South Australia on the Murraylink interconnector was limited to 187 MW by the thermal constraint equation V>S\_NWRB2\_NWRB1. This constraint equation limits the flow towards South Australia on Murraylink to prevent overload of Robertstown – North West Bend No 1 132 kV line, during the outage of the Robertstown – North West Bend No 2 132 kV line.

Following the commencement of the Penola West – South East 132 kV line planned outage at 0809 hrs, Ladbroke Grove GT units 1 and 2 were observed to be oscillating. Between 0809 hrs and 0915 hrs, each unit was oscillating with a magnitude of +/- 5 MW around a generation target of 43 MW. For DI ending 0915 hrs, the discretionary constraint equation #SA1\_E\_20160801 was invoked. This constraint equation limits output from Ladbroke Grove GT units 1 and 2 to 0 MW. Between DIs ending 0910 hrs and 0915 hrs, wind generation reduced by a further 14 MW.

The reduction in wind generation and available generation from Ladbroke Grove during the morning peak demand resulted in a tight supply situation in South Australia. Due to the tight supply, target flow towards South Australia on the Heywood interconnector increased and Ladbroke Grove GT units 1 and 2 were dispatched above the 0 MW limit set by the discretionary constraint equation,



#SA1\_E\_20160801. This caused the constraint equations #SA1\_E\_20160801 and S>>PWSE\_SETB\_SETB\_2 to violate for DI ending 0915 hrs. The S>>PWSE\_SETB\_SETB\_2 constraint equation prevents overload of either Tailem Bend – South East 275 kV line for the loss of the parallel line, during the outage of the Penola West – South East 132 kV line.

For DI ending 0915 hrs, the target flow towards South Australia on the Heywood interconnector increased to 402 MW, which violated the limit of 388.52 MW set by the thermal constraint equation S>>PWSE\_SETB\_SETB\_2. The target flow towards South Australia on the Murraylink interconnector was limited to 188 MW by the thermal constraint equation V>S\_NWRB2\_NWRB1.

For DIs ending 0910 hrs and 0915 hrs, lower priced generation was available, however was limited by ramp rates (Hallet PS, Torrens Island B unit 3, Dry Creek GT units 2 and 3, Snuggery PS), or required more than one DI to synchronise (Snuggery PS, Dry Creek GT unit 3, Quarantine PS unit 5). For DI ending 0915 hrs and 0920 hrs, Hallet GT was generating below their dispatch target, resulting in a deficit of 60 MW in South Australia.

The 5-minute price reduced to \$90.49/MWh for DI ending 0920 hrs, when Lumo Generation rebid 83 MW of generation capacity from bands priced at \$13,999.99/MWh or above to the Market Floor Price (MFP) of -\$1,000/MWh. The increased availability of lower priced generation in South Australia reduced the flow towards South Australia on the Heywood and Murraylink interconnectors, which prevented the S>>PWSE\_SETB\_SETB\_2 constraint equation from violating and the V>S\_NWRB2\_NWRB1 constraint equation from binding.

The constraint equations #SA1\_E\_20160801 violated for DI ending 0920 hrs as Ladbroke Grove GT units 1 and 2 were limited by their ramp down rates. This constraint equation ceased violating at DI ending 0925 hrs, when the dispatch target for Ladbroke units 1 and 2 reduced to 0 MW.

The high 30-minute spot price was not forecast in any of the pre-dispatch schedules, as it was due to the reduction in generation availability within the trading interval.

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## Wednesday 10 August 2016 – High FCAS price SA

**Market Outcomes:** South Australia Raise Regulation Frequency Control Ancillary Service (FCAS) price ranged between \$97.85/MWh and \$2,751.37/MWh for 34 trading intervals (TIs) between TIs ending 0730 hrs on 10 August 2016 and 0000 hrs on 11 August 2016. South Australia Lower Regulation FCAS price ranged between \$57.45/MWh and \$4,064.46/MWh for 29 TIs between TIs ending 1000 hrs on 10 August 2016 and 0000 hrs on 11 August 2016.

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

Actual Lack of Reserve Level 2 (LOR2) condition had been declared for the South Australia region between 0745 hrs on 10 August 2016 and 1135 hrs on 10 August 2016 (Market Notice 54687 and 54689) and between 1630 hrs on 10 August 2016 and 1130 hrs on 12 August 2016 (Market Notice 54693 and 54710). 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 Victoria, power interruptions would have been likely, due to automatic under-frequency load shedding. This would have been triggered as a result of ramp rate limitations, associated with dispatching additional generation in a short timeframe.



**Detailed Analysis:** The 5-minute Raise Regulation FCAS prices in South Australia reached the Market Price Cap (MPC) of \$14,000/MWh for dispatch intervals (DIs) ending 1905 hrs and 2325 hrs. The 5-minute Lower Regulation prices were at \$12,000.00/MWh for DIs ending 1750 hrs and 1755 hrs and at \$13,799.99/MWh for DIs ending 1905 hrs and 2325 hrs. These high prices were mainly attributed to increased Regulation FCAS requirements within South Australia during a planned outage of Heywood No.1 500 kV bus and limitations associated with available Regulation FCAS during some DIs. For all other DIs between TIs ending 0730 hrs on 10 August and 0000 hrs on 11 August, Regulation FCAS prices were elevated, ranging between \$20.00/MWh and \$300.00/MWh.

The Heywood No 1 500 kV Bus was on a planned outage between 0708 hrs on 10 August 2016 and 1254 hrs on 12 August 2016. This outage increased the risk of electrical separation between South Australia and Victoria. 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 the outage. The constraint equations F-S\_LREG\_0035 and F-S\_RREG\_0035 contained within the F-I-HYSE constraint set 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 and Pelican Point PS.

For DI ending 1750 hrs, the Regulation FCAS enablement maximum limit (SCADA) for Pelican Point GT reduced from 235 MW to 146 MW. The enablement maximum limit of 146 MW was below Pelican Point's Regulation FCAS trapezium minimum enablement limit of 158 MW. As a result, for DI ending 1750 hrs, Pelican Point was unavailable for Regulation FCAS.

For DI ending 1755 hrs, the Regulation FCAS enablement maximum limit (SCADA) for Pelican Point GT reverted to 235 MW. The unit's output of 155 MW, however, was below the Regulation FCAS trapezium minimum enablement limit of 158 MW. As a result, for DI ending 1755 hrs, Pelican Point was stranded (unavailable) for Regulation FCAS.

For DIs ending 1750 hrs and 1755 hrs, due to the above limitations associated with providing Regulation FCAS by Pelican Point GT, additional Lower Regulation FCAS had to be sourced from Torrens Island B PS at more expensive price bands. Consequently, the 5-minute Lower Regulation FCAS price reached \$12,000.00/MWh for both DIs.

The Lower Regulation FCAS price reduced to \$96.69/MWh for DI ending 1800 hrs when Pelican Point GT became available (not limited) for Regulation FCAS again.

For DIs ending 1905 hrs and 2325 hrs, Quarantine PS Unit 5 output (73 MW) was below its Regulation FCAS trapezium minimum enablement limit of 74 MW. As a result, Quarantine PS Unit 5 was stranded (unavailable) for Regulation FCAS and additional Regulation FCAS capacity had to be sourced from Pelican Point GT and Torrens Island B PS at more expensive price bands. The 5-minute Lower and Raise Regulation FCAS prices for both DIs exceeded \$13,799.00/MWh.

The Lower and Raise Regulation FCAS prices reduced to \$98.00/MWh or below, for DIs ending 1910 hrs and 2330 hrs, when Quarantine PS Unit 5 became available (not limited) for Regulation FCAS again. For DI ending 2330 hrs, AGL rebid 20 MW of Raise Regulation capacity from \$97.86/MWh to \$8.99/MWh.

For the high price TIs, between 0730 hrs on 10 August and 0000 hrs on 11 August, between 24 MW and 41 MW of Lower Regulation FCAS and 24 MW and 66 MW of Raise Regulation FCAS was available for less than \$100.00/MWh. For the same TIs, between 1 MW and 8 MW of Lower



Regulation FCAS and up to 5 MW of Raise Regulation FCAS was available between \$300.00/MWh and \$13,000.00/MWh, resulting in steep supply curves.

The high Regulation FCAS prices were forecast in all pre-dispatch schedules from 1300 hrs on 09 August 2016.

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## Thursday 11 to Friday 12 August 2016 – High FCAS price SA

**Market Outcomes:** South Australia Raise and Lower Regulation Frequency Control Ancillary Service (FCAS) prices ranged between \$96.69/MWh and \$11,469.00/MWh for all trading intervals (TIs) between TIs ending 0030 hrs 11 August 2016 and 1330 hrs on 12 August 2016.

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

Actual Lack of Reserve Level 2 (LOR2) conditions had been declared for the South Australia region between 1630 hrs on 10 August 2016 and 1130 hrs on 12 August 2012 during the planned outage of the Heywood No 1 500 kV Bus (Market Notices 54693 and 54710). 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 due to automatic under-frequency load shedding as a result of ramp rate limitations associated with dispatching additional generation in a short timeframe.

At 1925 hrs on 11 August 2016, the rolling sum of Lower 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 1930 hrs on 11 August 2016 and 0400 hrs on 19 August 2016 (Market Notices 54699 and 54759).

**Detailed Analysis:** The 5-minute Raise Regulation FCAS prices ranged between \$98.00/MWh and \$11,469.00/MWh for all DIs between 0005 hrs on 11 August and 1320 hrs on 12 August. The 5-minute Lower Regulation FCAS prices ranged between \$96.69/MWh and \$11,469.00/MWh for the same DIs. These high prices were mainly attributed to increased Regulation FCAS requirements within South Australia during a planned outage of Heywood No.1 500 kV bus and shifting of Regulation FCAS capacity to higher priced bands resulting in limited availability of lower priced Regulation FCAS in South Australia.

The Heywood No 1 500 kV Bus was on a planned outage from 0708 hrs on 10 August 2016 to 1254 hrs on 12 August 2016. This outage increased the risk of electrical separation between South Australia and Victoria. 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 the outage. The constraint equations F-S\_LREG\_0035 and F-S\_RREG\_0035 contained within the F-I-HYSE constraint set 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 and Pelican Point PS.

On 11 August 2016, until DI ending 1030 hrs there was at least 39 MW of Regulation FCAS capacity offered in bands priced at \$300.00/MWh or below. As a result, the Regulation FCAS prices ranged between \$96.69/MWh and \$124.99/MWh until then.



For DI ending 1035 hrs, Origin shifted 5 MW of Raise and Lower Regulation capacity from Quarantine PS unit 5 from \$0.00/MWh to bands priced at \$12,148.43/MWh or above. This shift resulted in more expensive Raise and Lower Regulation capacity (priced up to \$11,469.00/MWh) to be sourced from Torrens Island B PS and Pelican Point PS to meet the 35 MW Regulation requirement. The Lower and Raise Regulation FCAS price was \$11,469.00/MWh for all DIs between DIs ending 1035 hrs and 1130 hrs.

For DI ending 1135 hrs, Origin shifted 5 MW of Raise Regulation capacity from \$12,520.28/MWh to \$0.00/MWh and 2 MW of Lower Regulation capacity from \$12,148.43/MWh or above to \$11,141.52/MWh. As a result, the Raise Regulation FCAS price reduced to \$98.00/MWh between DIs ending 1135 hrs and 1230 hrs. The Lower Regulation FCAS price continued to stay high at \$10,990/MWh for all DIs between DIs ending 1135 hrs and 1230 hrs.

For DI ending 1235 hrs, Origin shifted 5 MW of Raise Regulation capacity from \$0.00/MWh to \$11,141.52/MWh. The Raise and Lower Regulation FCAS prices continued to stay high at \$10,990.00/MWh for all DIs between DIs ending 1235 hrs and 1925 hrs.

By DI ending 1925 hrs on 11 August 2016, the prolonged high prices caused the rolling sum of Lower Regulation FCAS prices in the South Australia region for the previous 2,016 DIs to exceed six times the CPT, thus triggering an Administered Price Period (APP). An APC of \$300/MWh was applied to all ancillary service prices for the South Australia region from DI ending 1930 hrs on 11 August 2016.

On 12 August 2016, the APC continued to apply since the cumulative sum of both Lower and Raise Regulation FCAS prices remained above the CPT. The 30-min Regulation FCAS prices ranged between \$96.69/MWh and \$300.00/MWh following the commencement of APP (at 1925 hrs on 11 August 2016) and completion of the Heywood No.1 500kV bus outage at 1315 hrs on 12 August 2016. For DI ending 1325 hrs, the Raise and Lower Regulation FCAS price reduced to \$28.98/MWh and \$3.00/MWh, respectively, when the outage constraint set F-I-HYSE was revoked following completion of the outage.

The APC was removed at 0400 hrs on 19 August 2016 when the cumulative sum of Lower and Raise Regulation FCAS prices reduced to below six times the CPT.

The high Regulation FCAS prices were forecast in all pre-dispatch schedules from 1300 hrs on 10 August 2016.

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## Wednesday 31 August 2016 to Friday 02 September 2016 – High FCAS price SA

**Market Outcomes:** South Australia Raise and Lower Regulation Frequency Control Ancillary Service (FCAS) prices ranged between \$286/MWh and \$12,899.99/MWh for all trading intervals (TIs) between TI ending 0730 hrs and 1730 hrs on the 31 August and 1 September and between TIs ending 0730 hrs and 1600 hrs on 02 September 2016.

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

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



- 0720 hrs and 1651 hrs on 31 August 2016 (Market Notices 54805 and 54811).
- 0710 hrs and 1709 hrs on 1 September 2016 (Market Notices 54820 and 54828).
- 0700 hrs and 1605 hrs on 2 September 2016 (Market Notices, 54833 and 54835).

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 due to automatic under-frequency load shedding as a result of ramp rate limitations associated with dispatching additional generation in a short timeframe.

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 Notice 54827 and 54877).

**Detailed Analysis:** The 5-minute Raise Regulation FCAS prices ranged between \$98/MWh and \$12,899.99/MWh for all DIs between 0705 hrs and 1700 hrs on 31 August 2016 and 1 September 2016, and 0705hrs and 1600 hrs on 2 September 2016. The 5-minute Lower Regulation FCAS prices ranged between \$286/MWh and \$12,035.03/MWh for the same DIs.

These high prices were mainly attributed to the application of local Regulation FCAS requirements within South Australia during a planned outage of the Moorabool – Tarrone No.1 500kV line and rebidding, resulting in limited availability of lower priced Regulation FCAS capacity in South Australia.

The Moorabool – Tarrone No.1 500kV line was on a planned outage between 0700 hrs and 1700 hrs on 31 August 2016 and 1 September 2016, and 0700 hrs and 1600 hrs on 2 September 2016. This outage increased the risk of synchronous separation between South Australia and Victoria. The outage constraint sets F-V-MLTR, S-BOTH\_BLKRG\_C\_OS, V-MACARTHUR\_ZERO and V-MLTR were invoked for the duration of the outage on each day. The constraint equations F\_S+LREG\_0035 and F\_S+RREG\_0035 contained within the F-V-MLTR constraint set 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) and Pelican Point PS.

### **31 August 2016**

On 31 August, until DI ending 0850 hrs, sufficient Raise and Lower Regulation capacity was offered in relatively lower price bands. Resultantly, prices in these markets ranged between \$300/MWh and \$519.70/MWh between DIs ending 0705 hrs and 0850 hrs.

For DI ending 0855 hrs, AGL rebid 11 MW each of Raise and Lower Regulation capacity from Torrens Island B PS from \$299.58/MWh to bands priced at \$9,986.02/MWh or above. This resulted in more expensive Raise and Lower Regulation capacity being sourced from Pelican Point PS and Torrens Island B unit 1 to meet the 35 MW Regulation requirement. The 5-min Raise and Lower Regulation prices ranged between \$12,000/MWh and \$12,899.99/MWh between DIs ending 0855 hrs and 0930 hrs.

For DI ending 0900 hrs, Origin bid 9 MW of generation capacity from QPS5 into the Raise and Lower Regulation FCAS markets. Due to QPS5's fast start inflexibility profile, the units output was below the Regulation FCAS trapezium minimum enablement limit of 74 MW until DI ending 0930 hrs. As a result, QPS5 could not provide Regulation FCAS until DI ending 0935 hrs. For DI ending 0935 hrs,



Raise and Lower Regulation prices reduced to \$474.70/MWh and \$300/MWh, respectively. Regulation FCAS prices remained between \$286.69/MWh and \$373.16/MWh until DI ending 1700 hrs, when the Moorabool – Tarrone No.1 500kV line outage ended for the day.

### **01 September 2016**

On 1 September, after the re-commencement of the Moorabool – Tarrone No.1 500kV line outage at 0700 hrs, sufficient Raise and Lower Regulation capacity was offered in relatively lower price bands, such that the 5-min prices for Raise and Lower Regulation FCAS ranged between \$300/MWh and \$530.46/MWh until DI ending 0720 hrs.

For DI ending 0725 hrs, AGL rebid 4 MW each of Raise and Lower Regulation capacity from Torrens Island B PS from bands priced at \$299.58/MWh to bands priced at \$9,986.02/MWh or above. The rebid resulted in more expensive Regulation capacity being sourced from Pelican Point at \$9,999.69/MWh to meet the 35 MW regulation requirement for SA. The 5-min Regulation prices remained between \$8,900.00/MWh and \$9,999.69/MWh until DI ending 1635 hrs.

By DI ending 1640 hrs on 1 September 2016, the prolonged high prices caused the rolling sum of Raise Regulation FCAS prices in the South Australia region over the previous 2,016 DIs to exceed six times the CPT, thus triggering an Administered Price Period (APP). An APC of \$300/MWh was applied to all ancillary service prices for the South Australia region from DI ending 1640 hrs on 1 September 2016.

For DI ending 1650 hrs, Origin rebid 36 MW each of Raise and Lower Regulation capacity from bands priced at \$11,626.12/MWh or above to \$292.98/MWh. As a result, the 5-min price for both Raise and Lower Regulation FCAS reduced to \$289/MWh. For DI ending 1655 hrs, AGL rebid 15 MW of Raise and Lower Regulation capacity from bands priced at \$9,986.02/MWh or above to bands priced at \$299.58/MWh or below. For this DI and the next, the Raise Regulation price reduced to \$98/MWh.

The Moorabool – Tarrone No.1 500kV line outage ended for the day at 1700 hrs.

### **02 September 2016**

On 2 September 2016, the APC continued to apply since the cumulative sum of both Lower and Raise Regulation FCAS prices remained above the CPT. The 30-min Regulation FCAS prices ranged between \$286/MWh and \$300/MWh for all DIs between DI ending 0705 hrs to 1605 hrs.

At DI ending 1610 hrs, the Raise and Lower Regulation FCAS price reduced to \$25/MWh and \$6/MWh, respectively, when the outage constraint set F-V-MLTR was revoked following completion of the outage for the day.

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.

The high Regulation FCAS prices were forecast in the latest pre-dispatch schedules, except for TIs ending 0930 hrs on 31 August and 0730 hrs on 1 September, due to rebidding within the affected TI, and TI ending 1700 hrs on 1 September, due to application of the APC during the TI.



