Electricity Pricing Event Reports

JULY 2016

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

Saturday 02 July 2016 – High FCAS price Mainland

Market Outcomes: The NEM had high Raise Regulation Frequency Control Ancillary Service (FCAS) prices, reaching $249.97/MWh for trading interval (TI) ending 2330 hrs. The Fast Raise and Regulation Raise prices reached up to $100.21/MWh and $111.39/MWh, respectively, for TI ending 2330 hrs.

Energy prices across all NEM regions were elevated, but did not reach the price threshold for reporting purposes.

Detailed Analysis: The 5-Minute Raise Regulation FCAS prices in the NEM reached between $97.53/MWh and $248.91/MWh between dispatch intervals (DIs) ending 2310 hrs and 2320hrs. The 5-minute Fast Raise FCAS prices reached between $77.71/MWh and $229.68/MWh for the same DIs. These high FCAS prices can be mainly attributed to increased regulation FCAS requirements in the NEM, due to an increased accumulated time error in the NEM. Other contributing factors include shifting and withdrawal of FCAS capacity, limited availability of cheaper priced FCAS capacity and steep supply curves in the Raise FCAS markets.

Between TIs ending 1430 hrs and 2300 hrs, wind generation reduced across South Australia from 342 MW to 96 MW and Victoria from 558 MW to 415 MW This contributed to an increase in the accumulated time error in the NEM.

The accumulated time error in the NEM had been continuously below -1.5 seconds since DI ending 2215 hrs. To manage the time error, the amount of Raise Regulation services enabled had been above the default level of 130 MW since DI ending 2215 hrs. Between DIs ending 2310 hrs and 2320 hrs, the accumulated time error in the NEM was between -1.86 seconds and -2.79 seconds. The amount of Raise Regulation services enabled increased from 136 MW for DI ending 2305 hrs to a maximum 207 MW for DI ending 2315 hrs.

For all high priced DIs, there was up to 19 MW of Raise Regulation capacity and up to 35 MW of Fast Raise capacity offered between $40/MWh and $400/MWh across all NEM regions, resulting in steep supply curves.

Between DIs ending 2305 hrs and 2315 hrs, NEM demand increased by 232 MW. During this period, a number of units providing cheaper priced FCAS in the Mainland were dispatched close to their maximum capacity in the energy market, which effectively reduced their Raise FCAS availability. Between DIs ending 2310 hrs and 2320 hrs, 5-minute energy prices were between $104.59/MWh and $323.70/MWh across all NEM regions.

For DI ending 2305 hrs, AGL shifted up to 160 MW of Torrens Island A and B Power Station's Fast Raise and Raise Regulation FCAS capacity from bands priced at $47.93/MWh or below to bands priced at $13,780.70/MWh with the reason '1150~F~00 INITIAL BID~'. For the same DI, Origin Energy withdrew 65 MW of Regulation Raise FCAS capacity from Mortlake PS with the reason '2240A ENERGY/FCAS TRADEOFF SL'.

For DI ending 2325 hrs, the 5-minute Raise Regulation and Fast Raise FCAS prices in the NEM reduced to $43.13/MWh and $33.53/MWh, respectively, when the time error recovered to within +/-2 seconds and the Raise Regulation requirement in the NEM reduced.

The high 30-minute NEM FCAS prices were forecast in the latest pre-dispatch schedule.

Monday 04 July 2016 – High FCAS price Mainland

Market Outcomes: The Mainland (Queensland, New South Wales, Victoria and South Australia) had high Raise Regulation Frequency Control Ancillary Service (FCAS) prices, reaching $93.44/MWh and $140.21/MWh for trading intervals (TIs) ending 0700 hrs and 0930 hrs, respectively.

FCAS and Energy prices in Tasmania were not affected by this event. Energy prices for the Mainland were elevated but did not reach the price threshold for reporting purposes.

Detailed Analysis: The 5-minute Raise Regulation FCAS prices in the Mainland ranged between $101.76/MWh and $195.37/MWh for 8 dispatch intervals (DIs) within the high priced TIs. The 5-minute Fast Raise, Slow Raise and Delayed Raise FCAS prices ranged between $10.00/MWh and $34.20/MWh between DIs ending 0635 hrs and 0700 hrs. These high FCAS prices can be mainly attributed to limited availability of cheaper priced Raise FCAS services. Other contributing factors include rebidding of FCAS capacity, and steep supply curves in the Raise FCAS markets.

Demand in the mainland increased by 1628 MW between DIs ending 0630 hrs and 0700 hrs. Several generating units providing cheaper priced Raise Regulation FCAS capacity were dispatched close to or at their maximum capacity in the energy market, which effectively reduced their Raise FCAS availability. These include Earing PS unit 2, Loy Yang B PS units 1 and 2, Yallourn PS units 2 and 3, Callide B PS units 1 and 2, Gladstone PS Unit 2. The energy prices across the mainland were elevated during this period.

For DI ending 0635 hrs, Origin and Energy Australia shifted up to 87 MW of Delay Raise, Fast Raise and Slow Raise FCAS capacity from bands priced at $1.00/MWh or below to bands priced at $15.37/MWh or above.

A number of units providing cheaper priced Raise Regulation, Fast Raise and Slow Raise FCAS in the Mainland were trapped or stranded (Bayswater PS Unit 1, Eraring PS Units 1, 2 and 4, Mt Piper PS Units 1 and 2, Callide PS B Unit 2, Gladstone PS Units 2, 3, 5 and 6, Torrens Island PS A Units 1, 2 and 3, Torrens Island PS B Unit 4, Dartmouth PS, McKay Creek PS, Yallourn PS Units 1, 2 and 3).

During the high priced DIs, the increased generation in the energy market combined with the unavailability of Regulation capacity from trapped or stranded units caused the Raise Regulation FCAS availability in the Mainland to decrease by up to 69 MW between consecutive DIs. The Fast Raise and Slow Raise FCAS availability decreased by up to 82 MW and 85 MW between consecutive DIs, respectively.

For all high priced DIs, there was up to 4 MW of Raise Regulation capacity offered between $75.10/MWh and $300.00/MWh across all NEM regions, resulting in a steep supply curve.

The Mainland Raise Regulation FCAS price reduced to $70.04/MWh for DI ending 0705 hrs, and to $50.00/MWh for DI ending 0935 hrs, when fewer units were trapped or stranded and the availability of Fast and Slow Raise FCAS increased.

The high 30-minute Mainland FCAS prices were not forecast in the latest pre-dispatch schedules due to generation shift in capacity within the high priced trading interval.

Tuesday 05 July 2016 – High FCAS price NEM

Market Outcomes: The NEM had high Raise Regulation Frequency Control Ancillary Service (FCAS) prices of $151.52/MWh, $239.85/MWh and $169.77/MWh for trading intervals (TI) ending 1000 hrs, 1030 hrs and 1200 hrs, respectively.

Energy prices across all NEM regions were elevated, but did not reach the price threshold for reporting purposes.

Detailed Analysis: The Raise Regulation FCAS prices in the NEM were above $150/MWh for 15 dispatch intervals (DIs) between DIs ending 0935 hrs and 1200 hrs. These high FCAS prices can be mainly attributed to increased FCAS requirements in the NEM, due to an increased accumulated time error in the NEM, limited availability of cheaper priced FCAS capacity and steep supply curves in the Raise Regulation markets.

Low frequency events (less than 49.85 Hz) in the NEM occurred at 0659 hrs for 22 seconds, between 0806 hrs and 0813 hrs for 100 seconds, at 0850 hrs for 8 seconds, at 0955 hrs for 8 seconds, between 1125 hrs and 1131 hrs for 174 seconds and at 1142 hrs for 4 seconds. In addition, sustained low frequency periods (between 49.99 Hz and 49.85 Hz) occurred throughout the day, contributing to an increase in the accumulated time error in the NEM.

The accumulated time error in the NEM was below -1.5 seconds for approximately 306 minutes between 0815 hrs and 1344 hrs. The minimum time error was -4.23 seconds at 1005 hrs. To manage the accumulated time error, the Raise Regulation requirement in the NEM was increased from 130 MW (default requirement) at 0815 hrs to between 175 MW and 250 MW for the high priced DIs between 0935 hrs and 1200 hrs.

For all high priced DIs, there was between 11 MW and 60MW of Raise Regulation capacity offered between $100/MWh and $645/MWh across all NEM regions, resulting in a steep supply curve.

A number of units providing cheaper priced FCAS across the NEM were dispatched close to their maximum capacity in the energy market, which effectively reduced their Raise Regulation FCAS availability. For the high priced TIs, 30-minute energy prices were elevated to between $227.56/MWh and $468.61/MWh across all NEM regions.

For DI ending 0935 hrs, CS Energy (Gladstone PS units 3 and 5) shifted 285 MW of generation capacity in the energy market from bands priced at $262.99/MWh or above to bands priced at $73/MWh or below. Between DIs ending 0930 and 0935 hrs, additional generation from Gladstone PS units 3 and 5 was dispatched into the energy market, effectively reducing their availability in the Raise Regulation Market from approximately 25 MW to 0 MW for both units. As a result, Raise Regulation services were procured from more expensive units in the NEM.

At 1021 hrs, Gladstone PS unit 2 tripped. Resultantly, for DI ending 1035 hrs, CS Energy withdrew 20 MW of Raise Regulation capacity form the unit with the reason ‘1027P TECHNICAL ISSUES-SL’.

The Raise Regulation prices in the NEM reduced to $100.00/MWh for DI ending 1205 hrs, when the time error recovered to within +/-3 seconds and the Raise Regulation requirement in the NEM reduced.

The high 30-minute FCAS prices were not forecast in the latest pre-dispatch schedules, as the Raise Regulation requirement in the NEM was set to its default value of 130 MW for all schedules.

Wednesday 06 July 2016 to Friday 08 July 2016 – High Energy price SA

Market Outcomes: Spot price in South Australia ranged between $508.89/MWh and $8,897.80/MWh for 41 trading intervals (TIs) between TIs ending 0600 hrs on 06 July 2016 and 0000 hrs on 09 July 2016.

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

Actual Lack of Reserve Level 1 (LOR1) conditions had been declared for the South Australia region between 1800 hrs and 1900 hrs on 06 July 2016 (Market Notices 54247 and 54248), between 1800 hrs and 2130 hrs on 07 July 2016 (MN 54306 and 54352) and between 1830 hrs and 2000 hrs on 08 July 2016 (Market Notices 54371 and 54378).

Detailed Analysis: The 5-Minute dispatch price in South Australia ranged between $503.70/MWh and the Market Price Cap (MPC) of $14,000/MWh for 83 dispatch intervals (DIs) between DIs ending 0600 hrs on 06 July 2016 and 2335 hrs on 08 July 2016. These high prices can be mainly attributed to a planned network outage limiting South Australia imports over the Heywood interconnector, low wind generation and a steep supply curve in South Australia.

The Tailem Bend West 275 kV Bus (including Tailem Bend to South East No 1 275 line) was on a planned outage between 0811 hrs on 04 July and 2039 hrs on 14 July. This planned outage reduced the interconnector capacity on the Heywood Interconnector. Constraint set S-TB_275KV_W_BUS was invoked for the duration of the outage.

The transient stability constraint equation V::S_TB_275KV_W_B_1, from the constraint set S-TB_275KV_W_BUS, limited the Heywood interconnector for all high priced DIs. This constraint equation prevents transient instability across the VIC-SA cut-set for the loss of the South East - Tailem Bend No. 2 275kV line, during the outage of the Tailem Bend West 275kV Bus (including Tailem Bend to South East No. 1 275kV line). The target flow on the Heywood interconnector ranged between 48 MW towards Victoria and 65 MW towards South Australia for all high priced DIs.

The target flow towards South Australia on the Murraylink interconnector ranged between 151 MW and 220 MW and was limited by one of the thermal constraint equations V^SML_NSWRB_2 and N^^V_NIL_1 or the upper transfer limit constraint equation VSML_220. The V^SML_NSWRB_2 constraint equation prevents voltage collapse in Victoria for loss of the Darlington Point – Buronga (X5) 220 kV line. The N^^V_NIL_1 constraint equation prevents voltage collapse in the southern areas of New South Wales for the loss of the largest Victorian generating unit or Basslink, under system normal conditions.

Several South Australian generating units were unavailable during the high priced DIs. Torrens Island B unit 3 (210 MW) and Pelican Point CCGT (510 MW) were unavailable for the duration of 06 to 08 July. Torrens Island A units 1, 3 and 4 were unavailable for periods during 06 and 07 July.

For all high priced 5-minute DIs, wind generation in South Australia was between approximately 0 MW and 366 MW, with an average of 51 MW.

Rebidding from lower priced bands to higher priced bands occurred in 17 of the high priced DIs. For these DIs, up to 397 MW of generation capacity was rebid from the Market Floor Price (MFP) of -$1,000/MWh to bands priced at $10,580.20/MWh or above.

For the high priced DIs on the 6 and 7 July 2016, between 0 MW and 67 MW was offered between bands priced at $500/MWh and $10,000/MWh, resulting in a steep supply curve. For the high priced DIs on 8 July 2016, between 84 MW and 460 MW were offered at bands priced between $500/MWh and $10,000/MWh.

Between DIs ending 2330 hrs and 2335 hrs on 8 July 2016, demand increased by 207 MW due to hot water load management. For DI ending 2335 hrs, wind generation was 284 MW.

Lower priced generation was limited due to ramp rates (Torrens Island A units 3 and 4, Hallet PS, Dry Creek GT unit 3, Snuggery PS, Osborne PS, Mintaro GT), or by fast start profiles (Snuggery PS, Dry Creek GT units 1, 2 and 3, Lonsdale PS, Angaston PS, Port Lincoln GT units 1 and 3, Port Stanvac PS 1, Hallet PS, Ladbroke Grove PS units 1 and 2, Quarantine PS unit 5) or required more than 1 DI to synchronise (Hallet PS, Snuggery PS, Dry Creek PS units 1, 2 and 3, Lonsdale PS, Port Lincoln GT units 1 and 3) or was constrained off by the thermal constraint equation V::S_TB_275KV_W_B_1 (Lake Bonney WF Stage 2 and 3).

For the DIs subsequent to the high priced DIs, the 5-minute dispatch price reduced to $499.68/MWh or below when up to 971 MW of generation capacity was rebid from positive priced bands to Market Floor Price of -$1,000/MWh.

High prices were forecast in the latest pre-dispatch schedules between the 06 July 2016 to 08 July 2016.

Monday 11 July 2016 – High Energy price SA, Negative Energy price VIC

Market Outcomes: Spot price was $2,324.03/MWh in South Australia and -$196.93/MWh in Victoria for trading interval (TI) ending 0000 hrs.

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

Detailed Analysis: 5-Minute dispatch price reached the Market Price Cap (MPC) of $14,000/MWh in South Australia and the Market Floor Price (MFP) of -$1000/MWh in Victoria for dispatch interval (DI) ending 2335 hrs. The high South Australian price and negative Victorian price can be mainly attributed to a spike in South Australian demand and resulting changes to interconnector flows during the outage of the Tailem Bend West 275 kV bus (including Tailem Bend – South East No. 1 275 kV line)

The Tailem Bend West 275 kV Bus (including Tailem Bend to South East No 1 275 kV line) was on a planned outage from 0811 hrs on 04 July and returned to service at 2039 hrs on 14 July. This planned outage reduced the interconnector capacity on the Heywood Interconnector. Constraint set S-TB_275KV_W_BUS was invoked for the duration of the outage.

Between DIs ending 2330 hrs and 2335 hrs, South Australian demand increased by 221 MW, due to hot water load management. As a result of the increased demand, flow across the Heywood, Murraylink and VIC-NSW interconnectors changed.

Between DIs ending 2330 hrs and 2335 hrs, the target flow on the Heywood interconnector was reversed from 45 MW towards Victoria to 13 MW towards South Australia by the transient stability

constraint equation, V::S_TB_275KV_W_B_1. This constraint equation prevents the transient instability across the VIC-SA cutset for the loss of the South East - Tailem Bend No. 2 275 kV line, during the outage of the Tailem Bend West 275 kV Bus (including Tailem Bend – South East No. 1 275 kV line).

Between DIs ending 2330 hrs and 2335 hrs, the thermal constraint equation V>>SML_NIL_CONT_7B reduced the flow towards Victoria on the Murraylink interconnector from 140 MW to 9 MW and reversed the flow on the VIC-NSW interconnector from 649 MW towards New South Wales to 326 MW towards Victoria. This constraint equation prevents the overload of the Buangor – Arrarat 66kV line for the loss of the Ballarat – Horsham 220kV line, under system normal conditions.

For DI ending 2335 hrs, the Victorian price reduced to -$1,000/MWh, due to the forced import from New South Wales and limited export to South Australia, causing the marginal dispatch of cheaper priced generation capacity within Victoria.

For DI ending 2335 hrs, only 84 MW of South Australian generation capacity was offered between $150/MWh and $13,330/MWh, resulting in a steep supply curve. The price in South Australia increased to the MPC for DI ending 2335 hrs.

Lower priced generation was available in South Australia but was limited due to ramp rates (Torrens Island PS B Units 3), required more than one DI to synchronise (Hallett PS, Dry Creek CGT unit 3) or was constrained off by the transient stability constraint V::S_TB_275KV_W_B_1 (Ladbroke PS, Lake Bonney WF and Snuggery PS unit 1).

For DI ending 2340 hrs, the 5-minute price reduced to $299.54/MWh in South Australia and increased to $0/MWh in Victoria, when 137 MW of generation capacity was rebid in South Australia from bands priced at or above $13,300.3/MWh to the Market Floor Price (MFP) of -$1,000/MWh.

The high 30-minute spot price for South Australia and low 30-minute price for Victoria were not forecast in the latest pre-dispatch schedule, as they occued as a result of a spike in 5-minute demand in South Australia during the affected TI.

Tuesday 12 July 2016 – High Energy price SA

Market Outcomes: Spot price in South Australia ranged between $951.26/MWh and $2,815.68/MWh for 6 trading intervals (TIs) between TIs ending 0900 hrs and 1830 hrs.

Energy prices in other NEM regions did not reach the price threshold for reporting purposes. FCAS prices in all regions were not affected by this event.

Actual Lack of Reserve Level 1 (LOR1) conditions had been declared for the South Australia region between 1830 hrs and 1930 hrs on 12 July 2016 (Market Notices 54458 and 54460).

Counter price flows caused negative settlement residues of approximately $141,000 to accumulate on the South Australia to Victoria directional interconnector between TIs ending 1600 hrs and 2100 hrs. AEMO managed negative residues from 1505 hrs to 1630 hrs and from 1800 hrs to 1900 hrs (Market Notices 54442, 54452, 54455 and 54457).

Detailed Analysis: For the high priced TIs, the 5-minute dispatch price in South Australia ranged between $578.81/MWh and the Market Price Cap (MPC) of $14,000/MWh for 15 dispatch intervals (DIs) between DIs ending 0845 hrs and 1830 hrs. These high prices can be mainly attributed to a planned network outage limiting Heywood interconnector flow, a steep supply curve in South Australia and planned generator outages.

The Tailem Bend West 275 kV Bus (including Tailem Bend to South East No 1 275 kV line) was on a planned outage between 0811 hrs on 04 July and 2039 hrs on 14 July. This planned outage reduced the interconnector capacity on the Heywood Interconnector. The outage constraint set S-TB_275KV_W_BUS was invoked during this period.

The transient stability constraint equation V::S_TB_275KV_W_B_1, within the constraint set S-TB_275KV_W_BUS, forced flow on the Heywood interconnector towards Victoria during the high priced DIs. This constraint equation prevents the transient instability across the VIC-SA cut-set for the loss of the South East - Tailem Bend No. 2 275 kV line, during the outage of the Tailem Bend West 275 kV Bus (including Tailem Bend – South East No. 1 275 kV line). For DIs ending 1825 hrs and 1830 hrs, the Heywood interconnector was also limited by the Negative Settlement Residue Management (NRM) constraint equation NRM_SA1_VIC1 and the thermal constraint equation S>>NIL_RBTU_WEWT. The S>>NIL_RBTU_WEWT system normal constraint equation prevents overload of the Waterloo East - Waterloo 132 kV line for the loss of the Robertstown - Tungkillo 275kV line. The target flow on the Heywood interconnector ranged between 133 MW and 216 MW towards Victoria during the high priced DIs.

The target flow towards South Australia on the Murraylink interconnector was limited up to 198 MW during the high priced DIs by the thermal constraint equation V^SML_NSWRB_2, the NRM constraint equation NRM_SA1_VIC1 and the upper transfer limit constraint equation VSML_220. The V^SML_NSWRB_2 constraint equation prevents voltage collapse in Victoria for loss of the Darlington Point – Buronga (X5) 220 kV line.

The maximum temperature in Adelaide was 12°C. The cold weather, in conjunction with high cloud cover, resulted in the South Australian demand remaining high following the morning peak, without the usual dip in the middle of the day associated with rooftop PV generation.

Several South Australian generating units were unavailable for the duration of the day, including Torrens Island A units 1, 2 and 4 (360 MW total) and Torrens Island B unit 4 (210 MW). In addition, Pelican Point CCGT (510 MW) had been unavailable since 28 April 2016. Torrens Island A unit 3 (120 MW) was available from DI ending 1235 hrs.

South Australia wind generation was high, generating an average of 997 MW during the high price TIs. Between DIs ending 1435 hrs to 1535 hrs, some wind generators in South Australia experienced high wind speed cut-out of turbines due to extreme wind conditions.

For all high priced DIs, less than 300 MW of South Australian generation capacity was offered between $300/MWh and $13,000/MWh, resulting in a steep supply curve.

At 1135 hrs, 81 MW of generation capacity was shifted from bands priced at $301.30/MWh or below to bands priced at $13,998/MWh or above.

For DI ending 1535 hrs, 515 MW of generation capacity was shifted from the Market Floor Price (MFP of -$1,000/MWh to bands priced at $119.99/MWh or above.

Lower priced generation was available but required more than one DI to synchronise (Dry Creek GT unit 1, Port Lincoln GT units 1 and 3, Mintaro GT, Snuggery PS, Quarantine PS units 1, 2, 3, 4 and 5), was limited by ramp rates (Dry Creek GT unit 2, Torrens Island PS B units 1 and 2), was limited by fast start profiles (Dry Creek GT unit 2, Port Stanvac PS 1, Angaston PS, Lonsdale PS, Snuggery PS) or was constrained off by the transient stability constraint equation V::S_TB_275KV_W_B_1 (Lake Bonney 2 and 3 wind farms) or the thermal constraint equation S>>NIL_RBTU_WEWT (Waterloo WF).

For the DIs subsequent to the high priced DIs, the 5-minute price reduced to $201.42/MWh or below, when up to 860 MW of generation capacity was rebid from bands priced at $124.99/MWh or above to the MFP.

The 5-minute price in South Australia reduced to -$987.68/MWh or below for 7 DIs between DIs ending 1520 hrs and 1600 hrs, when up to 941 MW of generation capacity was rebid from higher priced bands to the MFP. For DI ending 1605 hrs, the 5-minute price in South Australia returned to $301.30/MWh when 965 MW of generation capacity was rebid or shifted from the MFP to bands priced at $124.99/MWh or above.

Due to the counter-price flow on the South Australia to Victoria directional interconnector, the NRM constraint equation NRM_SA1_VIC1 was invoked for 29 DIs between DIs ending 1510 hrs and 1900 hrs. The counter price flows were a result of the outage constraint equation V::S_TB_275KV_W_B_1 forcing flow towards Victoria across the Heywood interconnector. The NRM constraint bound for 23 DIs during this period.

The high prices between DI ending 0900 hrs and 1830 hrs were not forecast in the latest Pre-dispatch schedules, due to the low demand and high wind generation forecasts in the Pre-dispatch runs.

Tuesday 12 July 2016 – High Energy price TAS*

Market Outcomes: Spot price in Tasmania reached $1,695.07/MWh and $602.95/MWh for trading intervals (TIs) ending 0900 hrs and 2100 hrs, respectively.

Energy and FCAS prices in other NEM regions were not affected by this event. FCAS prices in Tasmania were elevated but did not reach the price threshold for reporting purposes.

Detailed Analysis: The 5-Minute dispatch price in Tasmania reached $9,238.95/MWh and $2,488.93/MWh for dispatch intervals (DIs) ending 0850 hrs and 2040 hrs, respectively. These high prices can be mainly attributed to reclassification of transmission lines in Tasmania due to lightning in the vicinity, which increased the local FCAS requirement.

- In response to lightning storms in the area, the loss of both the Farrell – Sheffield No. 1 and No. 2 220 kV Lines was declared a credible contingency between 0845 hrs and 1025 hrs (Market Notices no. 54416 and 54431) and between 2035 hrs and 2210 hrs (Market Notices no. 54461 and 54464).
- The simultaneous loss of both lines would have resulted in the loss of some west coast generators (Bastyan, John Butters and Reece 2).
- Reclassification constraint sets F-T-FASH_N-2, T-FASH_N-2_HM_C and T-NIL_WCP_CLOSE were invoked during this period to manage the potential simultaneous loss of the transmission lines. This involved reducing the energy dispatched from West Coast generators

(Bastyan, John Butters, Reece 1, Reece 2, Mackintosh and Tribute) in the Energy market and reducing the enablement of Bastyan, John Butters and Reece 2 in the FCAS markets.

- The reclassification constraint sets reduced lower priced generation from Mackintosh and Reece 2 in the Energy markets, and more expensive generation (Gordon PS) had to be dispatched instead.
- Due to insufficient availability of Raise FCAS services, a number of Raise FCAS constraint equations within the reclassification constraint sets violated for DIs ending 0850 hrs and 2040 hrs.
- For the high priced DIs, additional lower priced generation was available but required more than one DI to synchronise (Bell Bay Three PS units 1 and 3 and Tamar Valley OCGT unit 4), or were limited by ramp rates (Poatina PS units 1 to 6 and Tribute PS).

The 5-minute price in Tasmania reduced to $407.17/MWh or below for the DIs following the high priced DIs, when:

- For DI ending 0855 hrs, up to 146 MW of additional generation capacity was made available by Hydro Tas (Gordon) in each of the Raise FCAS markets with the reason '0846A CONSTRAINT IN TRANSMISSION DIFFERENT FROM EXPECTED'. Increased availability of Raise FCAS services from generators in other parts of Tasmania reduced the enablement of West Coast generators in the Energy and FCAS markets.
- For DI ending 2045 hrs, Tasmania demand reduced by 87 MW.

The high energy prices were not forecast in Pre-dispatch schedules as it was a result of reclassification of transmission lines within the affected TI.

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

Wednesday 13 July 2016 – High Energy price SA

Market Outcomes: Spot price in South Australia ranged between $547.60/MWh and $7,068.49/MWh for 8 trading intervals (TIs) between TIs ending 0630 hrs on 13 July and 0000 hrs on 14 July.

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

Actual Lack of Reserve Level 1 (LOR1) conditions were declared for the South Australia region between 1800 hrs and 2100 hrs on 13 July 2016 (Market Notices 54478 and 54480).

Counter price flows caused negative settlement residues of approximately $133,000 to accumulate on the South Australia to Victoria directional interconnectors between TIs ending 0700 hrs and 1200 hrs. AEMO managed negative residues from 0900 hrs to 1000 hrs and from 1030 hrs to 1130 hrs (Market Notices 54466, 54467, 54468 and 54469).

Detailed Analysis: The 5-Minute dispatch price in South Australia ranged between $578.81/MWh and the Market Price Cap (MPC) of $14,000/MWh for 25 dispatch intervals (DIs) between DIs ending 0620 hrs and 2335 hrs. These high prices can be mainly attributed to a planned network outage limiting flow towards South Australia on the Heywood interconnector, planned generator outages and a steep supply curve in South Australia.

The Tailem Bend West 275 kV Bus (including Tailem Bend to South East No 1 275 kV line) was on a planned outage from 0811 hrs on 04 July and returned to service at 2039 hrs on 14 July. This planned outage reduced the interconnector capacity on the Heywood Interconnector. Constraint set S-TB_275KV_W_BUS was invoked for the duration of the outage.

The transient stability constraint equation V::S_TB_275KV_W_B_1, from the constraint set S-TB_275KV_W_BUS, limited the Heywood interconnector for all high priced DIs. This constraint equation prevents the transient instability across the VIC-SA cutset for the loss of the South East – Tailem Bend No. 2 275 kV line, during the outage of the Tailem Bend West 275 kV Bus (including Tailem Bend – South East No. 1 275 kV line). The target flow on the Heywood interconnector ranged between 78 MW and 282 MW towards Victoria for all high priced DIs between 0620 hrs and 1930 hrs.

For the high priced DIs between 0620 hrs and 1930 hrs, the target flow towards South Australia on the Murraylink interconnector was limited to between 210 MW and 220 MW by the thermal constraint equation V^SML_NSWRB_2 or the upper transfer limit constraint equation VSML_220. The V^SML_NSWRB_2 constraint equation prevents voltage collapse in Victoria for loss of the Darlington Point – Buronga (X5) 220 kV line.

In South Australia, Torrens Island B unit 4 (210 MW) had been unavailable since Sunday 10 July and Pelican Point CCGT (510 MW) had been unavailable since 28 April 2016. Torrens Island A units 1, 2 and 4 (120 MW) were available from DIs ending 1105 hrs, 1335 hrs and 0705 hrs respectively.

South Australian wind generation reduced, from 861 MW to 490 MW, between TIs ending 0630 hrs and 1000 hrs.

For the high priced DIs, between TIs ending 0630 hrs and 1030 hrs, up to 130 MW of generation capacity was offered between $400/MWh and $10,000/MWh, resulting in a steep supply curve in South Australia.

For DI ending 0905 hrs, Origin Energy and AGL shifted 44 MW of generation capacity from the Market Floor Price (MFP) of -$1,000/MWh to bands priced at $13,329.90/MWh or above.

For DI ending 0935 hrs, Origin Energy and Synergen shifted 100 MW from the MFP to bands priced at $13,300/MWh or above.

Due to the counter-price flow on the South Australia to Victoria directional interconnector, the Negative Settlement Residue Management (NRM) constraint equation NRM_SA1_VIC1 was binding for 19 DIs between DIs ending 0910 hrs and 1130 hrs and violating for DI ending 0905 hrs. The outage constraint equation V::S_TB_275KV_W_B_1 forced counter price flows toward Victoria across the Heywood interconnector, resulting in negative residues.

The 5-Minute dispatch price in South Australia was -$999.23/MWh or below for 7 DIs between DIs ending 0915 hrs and 1000 hrs, when up to 36 MW of generation capacity was rebid from bands priced at $13,300.30/MWh to the MFP. For the DIs subsequent to the negative priced DIs, the dispatch price increased to -$89.22/MWh or above, when wind generation decreased by up to 12 MW and target flows on the Heywood interconnector increased by up to 75 MW towards Victoria.

South Australian demand reached its daily maximum of 2,215 MW for TI ending 1900 hrs. Wind generation had been decreasing since 1600 hrs, and reached 334 MW and 275 MW for TIs ending 1900 hrs and 1930 hrs, respectively.

For the high priced DIs during TIs ending 1900 hrs and 1930 hrs, between 120 MW and 150 MW was offered between $400/MWh and $10,000/MWh, resulting in a steep supply curve in South Australia.

For the DIs subsequent to the high priced DIs (that is DIs ending 1900 hrs, 1920 hrs and 1935 hrs), the dispatch price in South Australia reduced to $484.99/MWh, when demand reduced by up to 32 MW.

Between DIs ending 2330 hrs and 2335 hrs, South Australian demand increased by 212 MW due to hot water load management. The 5-minute dispatch price reached $3,481.48/MWh for DI ending 2335 hrs. Wind generation in South Australia was low at 220 MW for DI ending 2335 hrs.

For DI ending 2335 hrs, target flow towards Victoria on the Heywood interconnector was limited to 32 MW by transient stability constraint equation V::S_TB_275KV_W_B_1, and the target flow towards South Australia on the Murraylink interconnector was limited to 86 MW by the system normal thermal constraint equation V>>SML_NIL_CONT_7B. The V>>SML_NIL_CONT_7B constraint equation prevents the overload of the Buangor – Arrarat 66kV line for the loss of the Ballarat – Horsham 220kV line.

For DI ending 2340 hrs, the 5-minute dispatch price in South Australia reduced to $48.52/MWh, when 100 MW of generation capacity was rebid or shifted from bands priced at $578.81/MWh or above to the MFP.

During the high priced DIs, lower priced generation was available but limited due to ramp rates (Dry Creek GT unit 2, Torrens Island PS B units 1 and 2), was limited byfast start profiles (Port Stanvac PS 1, Angaston PS, Lonsdale PS), required more than one DI to synchronise (Dry Creek GT units 1 and 2, Hallett GT, Port Lincoln GT units 1 and 3, Mintaro GT, Snuggery PS, Quarantine PS units 1, 2, 3, 4 and 5) or was constrained off by the transient stability constraint equation V::S_TB_275KV_W_B_1 (Lake Bonney WF Stage 2 and 3).

High energy prices were forecast in the latest Pre-dispatch schedules relevant to the high priced TIs.

Thursday 14 July 2016 – High Energy price SA

Market Outcomes: Spot price in South Australia ranged between $534.26/MWh and $6,917.55/MWh for 13 trading intervals (TIs) between TIs ending 0900 hrs and 2100 hrs.

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

Actual Lack of Reserve Level 1 (LOR1) conditions had been declared for the South Australia region between 1745 hrs and 2030 hrs on 14 July 2016 (Market Notices 54507 and 54508).

Detailed Analysis: The 5-Minute dispatch price in South Australia ranged between $578.81/MWh and $13,998.99/MWh for 41 dispatch intervals (DIs) between DIs ending 0845 hrs and 2045 hrs. These high prices can be mainly attributed to a planned network outage limiting Heywood interconnector flows, planned generator outages and a steep supply curve in South Australia.

The Tailem Bend West 275 kV Bus (including Tailem Bend to South East No 1 275 kV line) was on a planned outage from 0811 hrs on 04 July and returned to service at 2039 hrs on 14 July. This planned outage reduced the interconnector capacity on the Heywood Interconnector. Constraint set S-TB_275KV_W_BUS was invoked for the duration of the outage.

The transient stability constraint equation V::S_TB_275KV_W_B_1, from the constraint set S-TB_275KV_W_BUS, limited the Heywood interconnector for all high priced DIs. This constraint equation prevents the transient instability across the VIC-SA cutest for the loss of the South East - Tailem Bend No. 2 275kV line, during the outage of the Tailem Bend West 275kV Bus (including Tailem Bend to South East No. 1 275kV line). The target flow on the Heywood interconnector ranged between 60 MW and 233 MW towards Victoria for DIs between 0845 hrs and 2045 hrs. For DI ending 2050 hrs, target flow on the Heywood interconnector increased to 302 MW towards South Australia when the constraint set S-TB_275KV_W_BUS was revoked.

For all high priced DIs, the target flow towards South Australia on the Murraylink interconnector was limited to between 190 MW and 220 MW by the thermal constraint equation V^SML_NSWRB_2 or the upper transfer limit constraint equation VSML_220. The V^SML_NSWRB_2 system normal constraint equation prevents voltage collapse in Victoria for loss of the Darlington Point – Buronga (X5) 220 kV line.

Torrens Island B unit 4 (210 MW) was unavailable for all high priced DIs. Pelican Point CCGT (510 MW) was unavailable prior to TI ending 1430 hrs and between TI ending 1600 hrs and 2100 hrs between 60 MW and 240 MW was available.

For all high priced DIs, up to 216 MW of generation capacity was offered between $500/MWh and $12,000/MWh, resulting in a steep supply curve.

For all high priced DIs, South Australia wind generation was low, between 134 MW and 367 MW.

For each high priced DI ending between 0855 hrs and 0945 hrs, up to 43 MW of generation capacity was shifted or rebid from bands priced at $300.99/MWh or below to bands priced at $13,299/MWh or above.

For DIs ending 0915 hrs and 0930 hrs, Origin Energy withdrew 24 MW (Quarantine PS unit 1) and 19 MW (Quarantine PS unit 2), with the reasons ‘0905P CHANGE IN AVAIL - LOW GAS PRESSURE SL’ and ‘0922P CHANGE IN AVAIL - GAS PRESSURES ISSUES REVISED SL’, respectively.

For DI ending 1005 hrs, 424 MW of generation capacity was shifted from the Market Floor Price (MFP) of -$1,000/MWh to bands priced at or above $119.99/MWh by a number of market participants.

For DI ending 2035 hrs, 200 MW of generation capacity was shifted from bands priced at or below $300.99/MWh to bands priced at $409.99/MWh or above.

Lower priced generation was available but required more than one DI to synchronise (Quarantine PS unit 4), was limited by ramp rates (Port Lincoln GT unit 3), was limited by fast start profiles (Angaston PS 1, Port Stanvac PS 1) or was constrained off by the transient stability constraint equation V::S_TB_275KV_W_B_1 (Lake Bonney WF Stage 2 and 3).

The 5-minute price in South Australia reduced to $416.03/MWh or below for the DIs subsequent to the high priced DIs, when demand reduced by up to 41 MW and up to 545 MW of generation

capacity was rebid or shifted from bands priced at $119.99/MWh or above to bands priced at the Market Floor Price (MFP) of -$1,000/MWh.

The high energy prices were forecast in the latest Pre-dispatch schedules relevant to the high priced TIs.

Saturday 16 July 2016 – High Energy price SA*

Market Outcomes: Spot price in South Australia reached $1,992.34/MWh and $1,910.47/MWh for trading intervals (TIs) ending 1800 hrs and 1900 hrs.

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

Detailed Analysis: The 5-Minute dispatch price in South Australia reached $10,578.87/MWh and $10,669.99/MWh for dispatch intervals (DIs) ending 1800 hrs and 1840 hrs. These high prices can be mainly attributed to a planned network outage limiting Heywood interconnector flows. Other contributing factors include generator outages, low wind generation and a steep supply curve, during the evening peak demand period.

- Planned outage of the Tailem Bend – South East No.2 275kV line was scheduled from 1000 hrs on 16 July 2016 until 2049 hrs on 22 July 2016. This planned outage reduced the interconnector capacity on the Heywood Interconnector. Outage Constraint set S-TBSE_1 was invoked during this period.
- For DIs ending 1800 hrs and 1840 hrs, the target flow towards South Australia on the Heywood interconnector was limited to 2 MW and 0 MW, respectively, by the transient stability constraint equation V::S_SETB_TBSE_1. This constraint equation prevents transient instability across the VIC-SA cutset, for the loss of one South East – Tailem Bend 275kV line, during the outage of the parallel line.
- For the same DIs, the target flow towards South Australia on the Murraylink was limited to 208 MW and 197 MW, respectively, by the thermal constraint equation V^SML_NSWRB_2. This constraint equation prevents prevents voltage collapse in Victoria for loss of the Darlington Point – Buronga (X5) 220 kV line.
- Several South Australian generating units were unavailable during the day, including Torrens Island B unit 4 (210 MW) and Torrens Island A unit 1 (120 MW). Pelican Point CCGT (510 MW) had 240 MW available.
- Wind generation was low in South Australia, at 133 MW and 171 MW for TIs ending 1800 hrs and 1900 hrs, respectively.
- For the high priced DIs, generation capacity was offered either less than $410/MWh or above $10,578/MWh, resulting in a steep supply curve in South Australia.

For the DIs subsequent to the high priced DIs, the 5-minute price in South Australia reduced to $299.99/MWh or below, when:

- Up to 716 MW of generation capacity was rebid from bands priced at $79.99/MWh or above to the Market Floor Price (MFP) of -$1,000/MWh.

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

Monday 18 July 2016 – High Energy price SA*

Market Outcomes: Spot price in South Australia reached $1,930.20/MWh for trading interval (TIs) ending 1700 hrs.

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

Detailed Analysis: The 5-Minute dispatch price in South Australia reached $578.81/MWh and $10,569.00/MWh for dispatch intervals (DIs) ending 1640hrs and 1645 hrs. These high prices can be mainly attributed to a planned network outage limiting Heywood interconnector flows, generator outages, low wind, a steep supply curve and rebidding.

- Planned outage of the Tailem Bend – South East No.2 275kV line was scheduled from 1000 hrs on 16 July 2016 until 2049 hrs on 22 July 2016. This planned outage reduced the interconnector capacity on the Heywood Interconnector. Constraint set S-TBSE_1 was invoked for the duration of the outage.
- For DIs ending 1640 hrs and 1645 hrs, the transient stability constraint equation V::S_SETB_TBSE_1 forced the target flow on the Heywood interconnector to flow towards Victoria at 59 MW and 63 MW, respectively. This constraint equation prevents the transient instability across the VIC-SA cutset, for the loss of one South East – Tailem Bend 275kV line, during the outage of the parallel line.
- For the same DIs, the target flow towards South Australia on the Murraylink was limited to 220 MW by the upper transfer limit constraint equation VSML_220.
- Several South Australian generating units were unavailable during the day, including Torrens Island B unit 4 (210 MW) and Torrens Island A unit 1 (120 MW). Pelican Point CCGT (510 MW) had 240 MW available.
- Wind generation was low in South Australia, at 254 MW and 243 MW for DIs ending 1640 hrs and 1645 hrs, respectively.
- Between DIs ending 1635 hrs and 1645 hrs, demand increased by 47 MW and reached 1,538 MW for DI ending 1645 hrs.
- For the high priced DIs, only 15 MW of generation capacity was offered between $300.00/MWh and $10,569.00/MWh, resulting in a steep supply curve in South Australia.
- For DI ending 1840 hrs, Energy Australia rebid 35 MW from $578.81/MWh to $13,998.99/MWh.

The 5-minute price in South Australia reduced to $71.41/MWh for DI ending 1650 hrs, when:

- 524 MW of generation capacity was rebid from bands priced at $94.99/MWh to the Market Floor Price (MFP) of -$1,000/MWh.
- Demand decreased by approximately 24 MW.

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

Tuesday 19 July 2016 – High Energy price SA*

Market Outcomes: Spot price in South Australia reached $1,659.54/MWh for trading interval (TI) ending 0700 hrs.

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

Detailed Analysis: The 5-Minute dispatch price in South Australia reached $10,569.69/MWh for dispatch interval (DI) ending 0640 hrs. This high price can be mainly attributed to a planned network outages limiting flow across the Heywood and Murraylink interconnectors. Other contributing factors include planned generator outages, low wind generation and a steep supply curve in South Australia.

- Planned outage of the Tailem Bend – South East No.2 275kV line was scheduled from 1000 hrs on 16 July 2016 until 2049 hrs on 22 July 2016. This planned outage reduced the interconnector capacity on the Heywood Interconnector. Outage constraint set S-TBSE_1 was invoked during this period.
- For the high priced DI, the target flow towards South Australia on the Heywood interconnector was limited to 8 MW by the transient stability constraint equation V::S_SETB_TBSE_1 contained within the constraint set S-TBSE_1. This constraint equation prevents transient instability across the VIC-SA cutset for the loss of one South East – Tailem Bend 275kV line, during the outage of the parallel line.
- For the high priced DI, the target flow towards South Australia on the Murraylink interconnector was limited to 102 MW by the hard ramping constraint equation #R014291_014_RAMP_F. This ramping constraint equation was invoked in preparation for the planned outage of the Red Cliffs – Wemen 220 kV line.
- Several South Australian generating units were unavailable for the duration of the day. These include Torrens Island A unit 1 (120 MW) and Torrens Island B unit 4 (210 MW). Pelican Point CCGT (510 MW) had 240 MW available.
- For DI ending 0640 hrs, 40 MW of South Australian generation capacity was offered between $300/MWh and $10,569/MWh, resulting in a steep supply curve.
- For TI ending 0700 hrs, South Australia demand increased 97 MW and wind generation decreased by 31 MW to 244 MW.
- Lower priced generation was available but required more than one DI to synchronise (Hallet GT and Quarantine PS unit 5).

The 5-minute price in South Australia reduced to $76.63/MWh for DI ending 0645 hrs, when:

- 346 MW of generation capacity was rebid from bands priced at $94.99/MWh or above to MFP.

The 5-minute price in South Australia reduced to -$998.50/MWh for DI ending 0700 hrs, when:

- For DIs ending 0650 hrs and 0700 hrs, 470 MW and 20 MW, respectively, of generation capacity was rebid from $578.81/MWh and above to the MFP.
- For DI ending 0700 hrs, only 67 MW of South Australia generation capacity was offered between -$987/MWh and $10,569/MWh, resulting in a steep supply curve.

The 5-minute price in South Australia increased to $33.13/MWh for DI ending 0705 hrs, when:

- 777 MW of generation capacity was shifted from the MFP to bands priced at $94.99/MWh or above.

The high prices for DI ending 0640 hrs was not forecast in the latest pre-dispatch schedule, as it was a result of implementation of ramping constraints in the dispatch run, which limited flow on the Murraylink interconnector.

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

Friday 22 July 2016 AM – High Energy price SA

Market Outcomes: Spot price in South Australia reached $2,380.68/MWh for trading interval (TI) ending 0930 hrs.

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

Detailed Analysis: 5-Minute dispatch price reached the Market Price Cap (MPC) of $14,000/MWh in South Australia for dispatch interval (DI) ending 0920 hrs. This high price can be mainly attributed to an increase in South Australian operational demand, primarily due to the unplanned outage of a line and resulting loss of non-scheduled generation, during a planned network outage which limited Heywood interconnector flows.

Planned outage of the Tailem Bend – South East No.2 275kV line was scheduled between 1000 hrs on 16 July 2016 and 2049 hrs on 22 July 2016. This planned outage reduced the interconnector capacity on the Heywood Interconnector. Constraint set S-TBSE_1 was invoked for the duration of the outage.

At 0912 hrs, the Pt Lincoln – Sleaford 132kV line tripped due to lightning in the vicinity. As a result of this loss, Cathedral Rocks Wind Farm was disconnected from the network, causing available generation in South Australia to reduce by 30 MW. Additionally, Mt Miller Wind Farm reduced from 51 MW to 0 MW, however resumed generation 5 minutes later. Between DIs ending 0915 hrs and 0920 hrs, South Australian demand increased by 85 MW, mainly attributable to these reductions in non-scheduled generation.

Due to the increase in South Australian demand, between DIs ending 0915 hrs and 0920 hrs, the target flow towards Victoria on the Heywood interconnector reduced from 203 MW to 170 MW. The reduced target flow of 170 MW towards Victoria violated the export limit (171.97 MW towards Victoria) set by the transient stability constraint equation, V::S_SETB_TBSE_1. This constraint equation prevents transient instability across the VIC-SA cutset, for the loss of one South East – Tailem Bend 275kV line, during the outage of the parallel line. Between the same DIs, the transient stability constraint equation constrained off the output from Lake Bonney 2 and 3 wind farms by a total of 29 MW. The output from the wind farms could not be further reduced since they were limited by their ramp down rates. This caused constraint equation V::S_SETB_TBSE_1 to violate for DI ending 0920 hrs.

Between DIs ending 0915 hrs and 0920 hrs, the target flow towards South Australia on the Murraylink interconnector was limited to 220 MW by the upper transfer limit constraint equation VSML_220.

Several South Australian generating units were unavailable during the high priced DI. These included Torrens Island A units 1, 3 and 4 (360 MW total), Torrens Island B units 3 and 4 (420 MW total) and Pelican Point CCGT (510 MW).

Lower priced generation was available but required more than one DI to synchronise (Hallet GT), was limited by ramp rates (Torrens Island PS A unit 2, Torrens Island PS B units 1 and 2), or was constrained off by the transient stability constraint equation V::S_SETB_TBSE_1 (Lake Bonney 2 and 3 wind farms).

For DI ending 0925 hrs, the 5-minute price reduced to $27.74/MWh in South Australia when 277 MW of generation capacity was rebid in South Australia from $13,999.99/MWh or above to the Market Floor Price (MFP) of -$1,000/MWh and demand reduced by 31 MW.

The high 30-minute spot price for South Australia was not forecast in the latest pre-dispatch schedule, as it occurred as a result of a spike in 5-minute demand in South Australia during the affected TI.

Friday 22 July 2016 PM – High Energy price SA

Market Outcomes: Spot price in South Australia reached $2,484.65/MWh and $2,337.47/MWh for trading intervals (TIs) ending 1630 hrs and 1700 hrs respectively.

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

Detailed Analysis: 5-Minute dispatch price reached the Market Price Cap (MPC) of $14,000/MWh in South Australia for dispatch intervals (DIs) ending 1630 hrs and 1635 hrs. These high prices can be mainly attributed to a planned network outage limiting Heywood interconnector flows, planned generator outages and a reduction in wind generation.

Planned outage of the Tailem Bend – South East No.2 275kV line was scheduled from 1000 hrs on 16 July 2016 and returned to service at 2049 hrs on 22 July 2016. This planned outage reduced the interconnector capacity on the Heywood Interconnector. Constraint set S-TBSE_1 was invoked for the duration of the outage.

For DIs ending 1630 hrs and 1635 hrs, the target flow on the Heywood interconnector was forced to 28 MW and 25 MW, respectively, towards Victoria by the transient stability constraint equation, V::S_SETB_TBSE_1. This constraint equation prevents transient instability across the VIC-SA cutset, for the loss of one South East – Tailem Bend 275kV line, during the outage of the parallel line. For the same DIs, the target flow towards South Australia on the Murraylink was limited to 220 MW by the upper transfer limit constraint equation VSML_220.

Several South Australian generating units were unavailable during the high priced DIs. These included Torrens Island A units 1, 3 and 4 (360 MW total), Torrens Island B unit 3 (210 MW) and Pelican Point CCGT (510 MW).

South Australia wind generation reduced by 309 MW, from 918 MW for DI ending 1600 hrs, to 609 MW for DI ending 1635 hrs. The reduction in wind generation was caused by high wind speed cut-out of turbines at some wind farms due to extreme wind conditions.

For both high priced DIs, less than 120 MW of South Australian generation capacity was offered between $350/MWh and $10,549.68/MWh, resulting in a steep supply curve.

Lower priced generation was available but required more than one DI to synchronise (Hallet GT, Quarantine GT unit 5, Mintaro GT) or was constrained off by the transient stability constraint equation V::S_SETB_TBSE_1 (Lake Bonney WF Stage 2 and 3).

For DI ending 1640 hrs, the 5-minute price reduced to $17.86/MWh in South Australia when 745 MW of generation capacity was rebid from bands priced at or above $79.99/MWh to the Market Floor Price (MFP) of -$1000/MWh.

The high 30-minute spot price for South Australia was not forecast in the latest pre-dispatch schedule, due to lower demand forecast and higher wind generation forecast in the Pre-Dispatch runs.

Wednesday 27 July 2016 – High Energy price TAS*

Market Outcomes: Spot price in Tasmania reached $1,736.90/MWh for trading interval (TI) ending 1830 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 Tasmania reached $9,215.09/MWh for dispatch interval (DI) ending 1830 hrs. This high price can be mainly attributed to a reduction in available generation from Musselroe wind farm during the evening peak demand period.

- High wind speeds (> 23 m/s) at Musselroe Wind Farm caused high wind speed cut-out of some turbines, resulting in a reduction in generation output.
- Musselroe Wind Farm availability decreased by approximately 92 MW, from 115 MW at DI ending 1810 hrs to 23 MW at DI ending 1830 hrs.
- Demand reached a peak of 1,471 MW at DI ending 1830 hrs.
- Lower priced generation was available but limited by ramp rates (Gordon PS), or required more than one DI to synchronise (Tamar Valley Peaking Plant), or was constrained off by the thermal constraint equation T>>T_NIL_BL_EXP_6E (Fisher PS, John Butters PS).
- Between DIs ending 1820 hrs and 1830 hrs, the target flow on Basslink was forced towards Victoria by the thermal constraint equation T>>T_NIL_BL_EXP_6E. This constraint equation is a network control system protection scheme (NCSPS) constraint that prevents overload on a Sheffield-George Town 220 kV line for the loss of the parallel line.
- The reduction in generation availability from Musselroe during the evening peak demand as well as forced export to Victoria on Basslink resulted in a tight supply situation in Tasmania.
- Due to the tight supply, target flow towards Victoria on Basslink was limited to 89 MW. This caused the thermal constraint equation T>>T_NIL_BL_EXP_6E to violate for DI ending 1830 hrs.
- Between DIs ending 1825 hrs and 1830 hrs, the violated constraint reduced the generation from a number of Tasmanian generating units by approximately 67 MW.

The 5-minute dispatch price reduced to $254.39/MWh for DI ending 1835 hrs, when:

- Demand reduced by approximately 15 MW.

- Hydro Tas (Poatina units 3-6) offered up to 57 MW of additional generation capacity into the Raise Regulation, Slow Raise and Delayed Raise FCAS markets.
- The constraint equation T>>T_NIL_BL_EXP_6E was no longer violating.

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

Thursday 28 July 2016 – High Energy price TAS

Market Outcomes: Spot price in Tasmania reached $2,402.02/MWh for trading interval (TI) ending 0930 hrs.

Energy and FCAS prices in other regions were not affected by this event. Fast Raise FCAS price in Tasmania was elevated, but remained below the reporting threshold.

Detailed Analysis: The 5-Minute dispatch price in Tasmania reached the Market Price Cap (MPC) of $14,000/MWh for dispatch interval (DI) ending 0910 hrs. This high price can be mainly attributed to a reduction in available generation from Musselroe wind farm, during the morning peak demand period.

High wind speeds (> 23 m/s) at Musselroe Wind Farm caused high wind speed cut-out of some turbines, resulting in a reduction in generation output. Between DIs ending 0905 hrs and 0910 hrs, Musselroe Wind Farm availability decreased by approximately 94 MW, from 162 MW at DI ending 0905 hrs to 68 MW at DI ending 0910 hrs.

During the high priced DI, the target flow on Basslink was forced towards Victoria by the thermal constraint equation T>>T_NIL_BL_EXP_6E. This constraint equation is a network control system protection scheme (NCSPS) constraint that prevents overload on a Sheffield-George Town 220 kV line for the loss of the parallel line.

Lower priced generation was available but limited by ramp rates (Gordon PS, Poatina PS units 1 – 6), required more than one DI to synchronise (Tamar Valley Peaking PS unit 2) or was constrained off by the thermal constraint equation T>>T_NIL_BL_EXP_6E (Reece 2 PS, Fisher PS, Meadowbank PS, Trevallyn PS).

The reduction in available generation from Musselroe during the morning peak demand as well as forced export to Victoria on Basslink resulted in a tight supply situation in Tasmania. Due to the tight supply, target flow towards Victoria on Basslink was limited to 105 MW. This caused the thermal constraint equation T>>T_NIL_BL_EXP_6E to violate for DI ending 0910 hrs.

For DI ending 0910 hrs, the violated constraint reduced generation from a number of Tasmanian generating units by approximately 58 MW.

The decreased target flow towards Victoria on the Basslink interconnector resulted in increased FCAS Contingency Raise requirements in Tasmania. Prices for Fast Raise FCAS were elevated to $551.46, however remained below the reporting threshold.

The 5-minute dispatch price reduced to $76.61/MWh for DI ending 0915 hrs, when demand reduced by approximately 96 MW, 10 MW of generation capacity from Gordon PS was rebid from

$282.68/MWh to -$999.64/MWh and the constraint equation T>>T_NIL_BL_EXP_6E was no longer violating.

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