Electricity Pricing Event Report - Friday 10 February 2017

Market Outcomes: The spot price in South Australia (SA) was $2,112.80/MWh for trading interval (TI) ending 1530 hrs on 10 February 2017. Spot prices in New South Wales (NSW) ranged between $2,088.32/MWh and the Market Price Cap (MPC) of $14,000.00/MWh for all 6 TIs between TI ending 1600 hrs and TI ending 1830 hrs. Spot prices in Queensland (QLD) were $3,460.47/MWh and $12,221.40/MWh for TIs ending 1630 hrs and 1700 hrs, respectively.

Mainland Raise Regulation Frequency Control Ancillary Service (FCAS) prices ranged between $302.18/MWh and $1,348.94/MWh for 8 TIs between TI ending 1330 hrs and TI ending 1800 hrs. The Mainland Delayed Raise FCAS price was $1,292.68/MWh for TI ending 1600 hrs.

Spot prices in other regions were occasionally elevated, but did not reach the price threshold for reporting purposes. FCAS prices in Tasmania (TAS) were not materially affected by this event.

An Actual Lack of Reserve Level 1 (LOR1) condition was declared for the NSW region from 1250 hrs to 1930 hrs (MN 57359 and 57406), and an Actual Lack of Reserve Level 2 (LOR2) condition declared from 1635 hrs (MN 57387). During this LOR2 period, some generators reduced output or were unavailable due to plant issues, resulting in insufficient generation to meet demand and created an insecure operating state as the flow on all the interconnectors connected to NSW were violating their limits. Following this, AEMO declared an Actual Lack of Reserve Level 3 (LOR3) condition from 1650 hrs to 1805 hrs (MN 57396 and 57400) and instructed[1] TransGrid to shed one Tomago aluminium smelter potline load (290 MW) between 1658 hrs and 1801 hrs to restore the power system to a secure operating state (MN 57397 and 57399). AEMO set the dispatch price in NSW to the MPC for all dispatch intervals (DIs) between DIs ending 1710 hrs and 1810 hrs, in accordance with the National Electricity Rules (NER).

Detailed Analysis:

<u>High energy prices in South Australia</u>

The 5-minute dispatch price in South Australia (SA) reached $10,585.99/MWh at dispatch interval (DI) ending 1520 hrs. This high price can be attributed to high SA demand while interconnector support was constrained and limited lower priced generation was available.

Demand in SA was high during the high priced TI, reaching 2,704 MW. This high demand coincided with high temperatures in SA, with a daily peak of 40 degrees (Adelaide).

Between DIs ending 1515 hrs and 1520 hrs, SA demand increased by 49 MW.

For DI ending 1520 hrs, the target flow on the Heywood Interconnector towards SA was limited to 600 MW by constraint equation V:S_600_HY_TEST. This constraint equation limits the upper transfer limit on the VIC to SA Heywood Interconnector to 600 MW. For the same DI, the target flow on the Murraylink Interconnector towards SA was limited to 42 MW by thermal constraint equation V>SML_NSWRB_10. This constraint equation is a system normal constraint equation that avoids the overload of the Kerang – Wemen 220 kV line for the loss of the Balranald – Darlington Point (X5/1) 220 kV line when the NSW Murraylink runback scheme is disabled.

For DI ending 1520 hrs, lower priced generation was available but required more than one DI to synchronise (Snuggery GT).

[1] A direction issued under section 116 of the NEL is referred to in clause 4.8.9 (a1)(2) as a clause 4.8.9 instruction.

The 5-minute dispatch price in SA reduced to $497.85/MWh for DI ending 1525 hrs when 335 MW of generation capacity was rebid from higher price bands to the Market Floor Price (MFP) of -$1,000.00/MWh.

The high spot price for SA was not forecast in the pre-dispatch schedules as these schedules took into account a lower than actual demand.

High energy prices in New South Wales and Queensland

The 5-minute dispatch prices in New South Wales (NSW) reached between $4,841.41/MWh and the MPC for 11 DIs between DIs ending 1545 hrs and 1705 hrs. For these same 11 DIs, the 5-minute dispatch prices in Queensland (QLD) were also high, reaching between $4,497.90/MWh and $13,387.66/MWh. In NSW, the MPC override was applied for an additional 13 DIs from DI ending 1710 hrs to 1810 hrs due to load shed in NSW following an instruction from AEMO. These high prices can mainly be attributed to high demand, unplanned generator outages, insufficient scheduled generator capacity while interconnector support was constrained and limited lower priced generation.

Demand in NSW was high during the high priced TIs, reaching the daily peak of 14,087 MW for TI ending 1700 hrs. This was the highest operational demand in NSW since February 2011, when a record peak demand of 14,744 MW was recorded. The high demand coincided with high temperatures in NSW, with a daily peak of 44.5 degrees (Bankstown Airport). Demand in QLD was high during the high priced TIs, reaching the daily peak of 8,781 MW for TI ending 1700 hrs. This high demand coincided with high temperatures in QLD, with a daily peak of 34.8 degrees (Archerfield Airport). Solar PV generation and wind generation in the regions were also decreasing throughout the high price DIs (refer to System Event Report for detailed studies for wind and solar generation).

In NSW at 1622 hrs, Tallawarra unit 1 tripped (408 MW) due to a fault in the gas turbine. This caused the N>>N-NIL__S constraint equation limiting interconnector flow into NSW to violate in DI ending 1630 hrs, indicating that the power system was not in a secure operating state. AEMO is required to take all reasonable actions to return the power system to a secure operating state as soon as reasonably practicable, and in any event within 30 minutes. AEMO sought advice from Generators with plant in NSW as to the availability of their generating plant. Furthermore, between DI ending 1645 hrs and 1650 hrs, Snowy Hydro withdrew all generation capacity for all 4 Colongra units (a total of 708 MW) as it had failed to start due to low gas pressure in the dual supply lines. Colongra unit 4 came back into service at DIs ending 1700 hrs and started generating at DI ending 1710 hrs, whilst Colongra units 2 and 3 came back into service at DI ending 1705 hrs and started generating at DI ending 1715 hrs.

As a result, before the MPC override, flow on the Queensland – New South Wales Interconnector (QNI) ranged between 909 MW and 1,193 MW towards NSW during these high priced DIs, and flow on the Terranora Interconnector ranged between 92 MW and 171 MW towards NSW. Both interconnectors were limited by constraint equation N>>N-NIL__S, and violated the limit it set in the same 7 DIs (all DIs between 1630 hrs and 1705 hrs except 1645 hrs). This system normal constraint equation avoids the overload of the Mt Piper – Wallerawang No.70 330 kV line for the loss of the Mt Piper – Wallerawang No.71 330 kV line.

As the QNI and Terranora Interconnector constraint equations were violated (importing into NSW) for most of the high priced DIs, high priced QLD generators set the price in both NSW and QLD.

Flow on the Victoria – New South Wales interconnector ranged between 243 MW and 576 MW towards NSW during these high priced DIs, limited by constraint equations V>>V_NIL_5 and N>>N-

NIL__S, and violating the N>>N-NIL__S constraint equation for 7 DIs. The V>>V_NIL_5 system normal constraint equation avoids the overload of either Mount Beauty – Dederang 220 kV line (flow to North) for the loss of the parallel line.

For the high priced DIs in NSW, lower priced generation was available, but was limited due to ramp rates (Eraring unit 3) or constrained by the system normal constraint equations N>>N-NIL__S, N>>N-NIL_A_15M, N>>N-NIL_B_15M and N>>N-NIL_H_15M (Mt Piper unit 2, Tumut 3, Upper Tumut). The N>>N-NIL_A_15M system normal thermal constraint equation avoids the overload of the Lower Tumut – Canberra No.7 330 kV line for loss of the Upper Tumut – Canberra No.1 330 kV line. The N>>N-NIL_B_15M system normal thermal constraint equation avoids the overload of the Upper Tumut – Canberra No.1 330 kV line for loss of the Lower Tumut – Canberra No.7 330 kV line. The N>>N-NIL_H_15M system normal thermal constraint equation avoids the overload of the Lower Tumut – Canberra No.7 330 kV line for loss of the Lower Tumut – Yass No.3 330 kV line.

For most high priced DIs in QLD, lower priced generation was available, but was limited due to ramp rates (Callide Power units 3 & 4, Millmerran units 1 & 2, Stanwell units 2 & 3 and Tarong units 1, 2, 3 & 4 and Tarong North) or constrained by their FCAS profile (Stanwell unit 4).

At 1650 hrs, an LOR3 condition was declared in NSW (MN 57396). At 1658 hrs, AEMO issued an instruction to TransGrid to shed one Tomago aluminium smelter potline load to restore power system security in accordance with section 116 of the National Electricity Law (NEL) (MN 57397). Load was shed by 1706 hrs, and at DI ending 1710 hrs the N>>N-NIL__S constraint equation was no longer violating, thereby returning the power system to a secure operating state. AEMO manually set the dispatch price in NSW to the MPC (MPC Override) from DI ending 1710 hrs. NER clause 3.9.2(e)(1) states that following an instruction for load shedding in a region, AEMO must set the dispatch price to the MPC for that region. At 1805 hrs, the LOR3 condition ended (MN 57400), with AEMO cancelling the direction to TransGrid and giving it permission to restore all Tomago aluminium smelter load at 1801 hrs (MN 57399). AEMO removed the MPC from DI ending 1815 hrs.

The NSW 5-minutes dispatch prices reduced to $108.39/MWh or below in the DIs subsequent to the high priced DIs, when interconnector inflows into NSW increased or demand in the NSW region decreased.

The QLD 5-minute dispatch prices reduced to $113.60/MWh or below in the DIs subsequent to the high-priced DIs, when demand in the QLD and NSW regions decreased and rebidding of QLD generation capacity of up to 34 MW from the MPC to the MPF occurred.

The high 30-minute spot prices for NSW and QLD were forecast in the pre-dispatch schedules.

For further details regarding the load shedding, please refer to AEMO's System Event Report.

High FCAS prices in NEM Mainland

The 5-minute Mainland Raise Regulation FCAS prices were between $300/MWh and $3,999.99/MWh for 38 DIs between DIs ending 1310 hrs and 1745 hrs. The 5-minute Mainland Delayed Raise FCAS prices were $3,208.44/MWh and $3,999.99/MWh for DIs ending 1545 hrs and 1550 hrs, respectively. These high prices can be attributed to an increase in the Mainland Raise Regulation requirement due to an increasing time error, while lower priced Raise Regulation were unavailable due to dispatch in the energy market.

Coincident with the high demand across the NEM in the afternoon, the accumulated time error in the Mainland fell below -1.5 sec for most of the high priced DIs, reaching a low of -4.20 sec. To

manage the time error, the amount of Raise Regulation FCAS enabled in the Mainland was elevated above the base requirement of 130 MW for the high priced DIs. Mainland Raise Regulation FCAS requirements reached a maximum of 280.42 MW at DI ending 1655 hrs. The increased Mainland Raise Regulation FCAS requirement was managed by constraint equation F_MAIN+NIL_DYN_RREG. This constraint equation increases the Mainland Raise Regulation Requirement by 60 MW for each 1 sec of time error below -1.5 sec. The additional Raise Regulation had to be sourced from more expensive generating units.

Between DI ending 1540 hrs and 1545 hrs, NEM total demand increased by 111 MW. For DI ending 1545 hrs, Snowy Hydro rebid 1,230 MW of generation capacity from band priced at $449.81/MWh to band priced at $13,994.00/MWh. The increased demand and rebidding of generation capacity contributed to the dispatch prices for DI ending 1545 being elevated, reaching between $3,500.69/MWh and $5,747.69/MWh across the Mainland regions. During this period, the flow on the Basslink Interconnector towards Victoria increased and a number of generating units providing cheaper priced FCAS in TAS were dispatched closer to their maximum capacity in the energy market, thus effectively reducing their Raise FCAS availability. The increase in Basslink Interconnector flow towards VIC caused the requirement for Raise FCAS in the Mainland to increase. During the tight supply demand period, there was limited availability of cheaper priced Raise Regulation and Delayed Raise FCAS capacity across the Mainland. The increase in Raise Regulation and Delayed Raise FCAS requirements was managed by FCAS constraint equations, F_I+NIL_MG_R5 and F_MAIN++NIL_MG_R5.

The Mainland FCAS prices for Raise Regulation and Delayed Raise services reduced to $299.99/MWh or below in the DIs subsequent to the high priced DIs, when the time error was above -1.5 sec.

The high Raise FCAS prices on the Mainland were not forecast in pre-dispatch schedules as the increased time error occurred within the TIs and the constraint equation F_MAIN+NIL_DYN_RREG that manages the Mainland Raise Regulation FCAS requirement was not modelled in pre-dispatch.