Report into market ancillary service prices above $5000/MW

South Australia, 24 October 2017

12 January 2018

AUSTRALIAN ENERGY REGULATOR

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1 Obligation

The Australian Energy Regulator regulates energy markets and networks under national legislation and rules in eastern and southern Australia, as well as networks in the Northern Territory. Its functions include:

- monitoring wholesale electricity and gas markets to ensure energy businesses comply with the legislation and rules, and taking enforcement action where necessary;
- setting the amount of revenue that network businesses can recover from customers for using networks (electricity poles and wires and gas pipelines) that transport energy;
- regulating retail energy markets in Queensland, New South Wales, South Australia, Tasmania (electricity only), and the ACT;
- operating the Energy Made Easy website, which provides a retail price comparator and other information for energy consumers;
- publishing information on energy markets, including the annual State of the energy market report, to assist participants and the wider community.

The AER is required to monitor significant variations between forecast and actual prices and publish a report where:

- prices for a market ancillary service over a period significantly exceed the relevant spot price for energy; and
- prices for a market ancillary service exceed $5000/MW for a number of trading intervals within that period.

In accordance with the clause 3.13.7(e) of the National Electricity Rules, the report must:

- describe the significant factors that contributed to the ancillary service prices exceeding $5000/MW;
- identify any linkages between spot prices in the energy market and ancillary service prices contributing to the occurrence; and
- assess whether rebidding pursuant to clause 3.8.22 contributed to prices exceeding $5000/MW.

These reports examine the reasons for the high price outcomes—they are not compliance reports. We deal separately with compliance issues that come to our attention during the preparation of these reports.

2 Summary

Lower and raise regulation frequency control ancillary services (regulation services) are used to manage small fluctuations in supply or demand.

On the evening of 24 October 2017 the price for regulation services in South Australia exceeded $5000/MW for 23 and 26 consecutive dispatch intervals respectively, from around 6.30 pm to 8.30 pm. This was much higher than the wholesale (or spot) price for electricity in South Australia, which was below -$30/MWh for the same period. The negative spot prices were driven by large amounts of wind generation in South Australia.

At 6.12 pm there was an unplanned network outage in Victoria affecting the Heywood interconnector. This outage put South Australia on a single contingency which created the risk of South Australia becoming electrically isolated from the National Electricity Market (NEM). To manage this risk, and in line with its procedures, the market operator (AEMO) invoked constraints that required the South Australian region to source 35 MW of regulation services locally for the duration of the outage.

While there was enough lower regulation services to meet the 35 MW requirement when it was invoked at 6.25 pm, only 24 MW of this was priced less than $5000/MW, so capacity priced above $5000/MW was dispatched to satisfy the requirement

For raise regulation services there was initially over 35 MW of low priced capacity to meet the requirement. In response to the outage, AGL rebid 16 MW of raise regulation services from prices below to above $5000/MW. This resulted in less than 35 MW of capacity priced below $5000/MW from 6.40 pm and the price increased above $5000/MW.

The high prices ended at 8.30 pm when the affected line which caused the outage was returned to service and the 35 MW requirement was removed by AEMO.

3 Analysis

The following sections explain the reasons for the high regulation services prices. To summarise, in response to an unplanned network outage in South Australia on the Heywood interconnector, AEMO imposed the requirement that 35 MW of regulation services be sourced locally in South Australia. While participants offered more than 35 MW of raise and lower regulation services, only 24 MW of lower regulation service capacity was priced less than $5000/MW and therefore higher priced capacity was needed to meet the requirement. For raise regulation services, after a rebid by AGL at its Torrens Island power station, there was only 24 MW priced less than $5000/MW and higher priced capacity was needed to meet the requirement.

The price for both services reached or exceeded $11 499/MW for all dispatch intervals from 6.25 pm to 8.30 pm (lower) and 6.40 pm to 8.30 pm (raise). The high prices for both services ceased once the affected line which caused the outage was returned to service.

3.1 Unplanned network outage

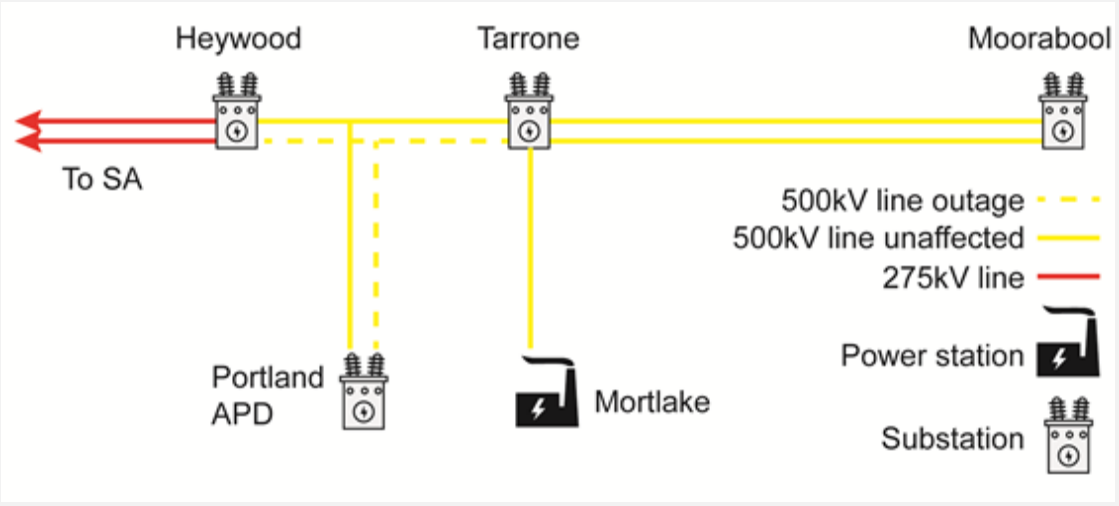
Market notice 59594 published at 6.26 pm, (replicated in Appendix E) advised the market there was an unplanned outage of the Heywood – Mortlake – APD No.2 500 kV line and constraints which require South Australia to source 35 MW of regulation services locally had been invoked from 6.20 pm. The 35 MW requirement, which occurs when South Australia is on a single contingency, is further explained in Box 1.

Market notice 59599, published at 8.38 pm, announced that the Heywood – Mortlake – APD No.2 500 kV line had been restored at 8.18 pm and the 35 MW local requirement was removed at 8.30 pm.

All market notices relating to the outage are in Appendix E.

Box 1: Heywood Interconnector and line outage management

South Australia is electrically connected to Victoria by the Heywood and Murraylink interconnectors. Murraylink is a direct current interconnector that cannot provide FCAS. The Heywood Interconnector is an alternating current high voltage transmission link which can transfer FCAS from the rest of the NEM. The figure below is a simplified representation of the network around the interconnector.



When any one of the four lines going through the Heywood substation is on an outage, the South Australian region is on a single contingency. This means that South Australia is at risk of being electrically isolated from the rest of the NEM as only one line is connecting South Australia to Victoria. When this occurs AEMO invokes constraints requiring 35 MW of local regulation services. This ensures adequate regulation services are immediately available to manage the frequency (around 50Hz) within South Australia if the remaining line trips.

Further details on the 35 MW requirement can be found in Appendix B.

3.2 Regulation FCAS capacity, forecast prices and price outcomes

This section discusses participants' FCAS offers and price outcomes.

3.2.1 FCAS capacity

Of the 26 power stations (including wind farms) in South Australia only four are registered to provide FCAS. Table 1 shows the power stations that were registered to provide raise and lower regulation FCAS in South Australia on the day and their maximum registered capacity. Table 1 shows each power station, if fully operational, was individually capable of providing the local requirement.

Table 1: Registered maximum regulation FCAS capacity by station

Power Station	Registered Capacity (MW)	
	Lower regulation	Raise regulation
Osborne (Origin Energy)	36	36
Quarantine (Origin Energy)	50	50
Pelican Point (Engie)	100	100
Torrens Island (AGL)	200	260
Total	**386**	**446**

On the day, Osbourne power station, half of Pelican Point and five units at Torrens Island power station were unavailable. So, although the registered capacity is as shown in Table 1, participants only offered around 145 MW of lower regulation and around 175 MW of raise regulation services.

3.2.2 Price outcomes and rebidding

Figure 1 and Figure 2 show actual price (purple line)[1] and effective available capacity over the high price period. The (constant) 35 MW requirement is shown as a red line. The blue shaded areas indicate effective available capacity priced below $5000/MW and effective available capacity priced above $5000/MW is indicated by the light orange shaded areas.

Figure 1 shows that, as there was not enough low priced capacity (blue shaded area) to meet the requirement for lower regulation service (red line), high priced capacity (light orange shaded area) was required, resulting in lower regulation prices of around $11 700/MW and above from 6.25 pm until 8.30 pm inclusive, after which time the requirement was removed.

Figure 2 shows that there was enough low priced capacity (blue shaded area) to meet the requirement for raise regulation service (red line) when it was introduced at 6.25 pm.

At 6.32 pm, effective from 6.40 pm, AGL rebid 16 MW of raise regulation services at its Torrens Island power station from prices less than $12/MW to $11 500/MW and above. This is shown by the decrease in low priced capacity (blue shaded area) from 6.40 pm in Figure 2. This resulted in capacity priced less than $5000/MW decreasing to 24 MW and the price of raise regulation services increasing to around $11 500/MW and above from 6.40 pm to 8.30 pm, after which time the requirement was removed.

[1] Individual prices are contained in the Price Setter at Appendix F

Figure 1: Lower regulation effective offers, requirement and price

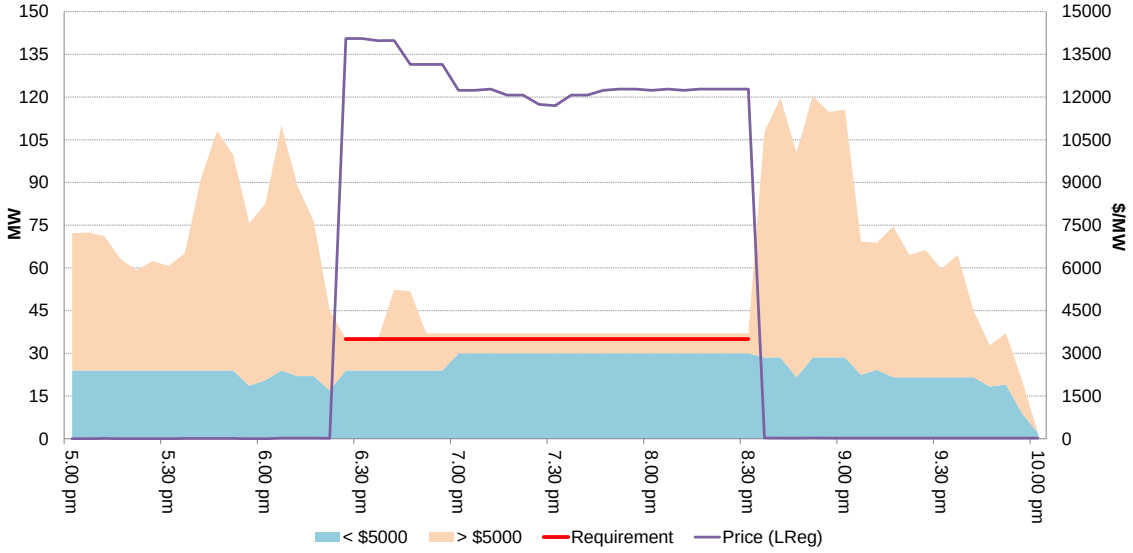
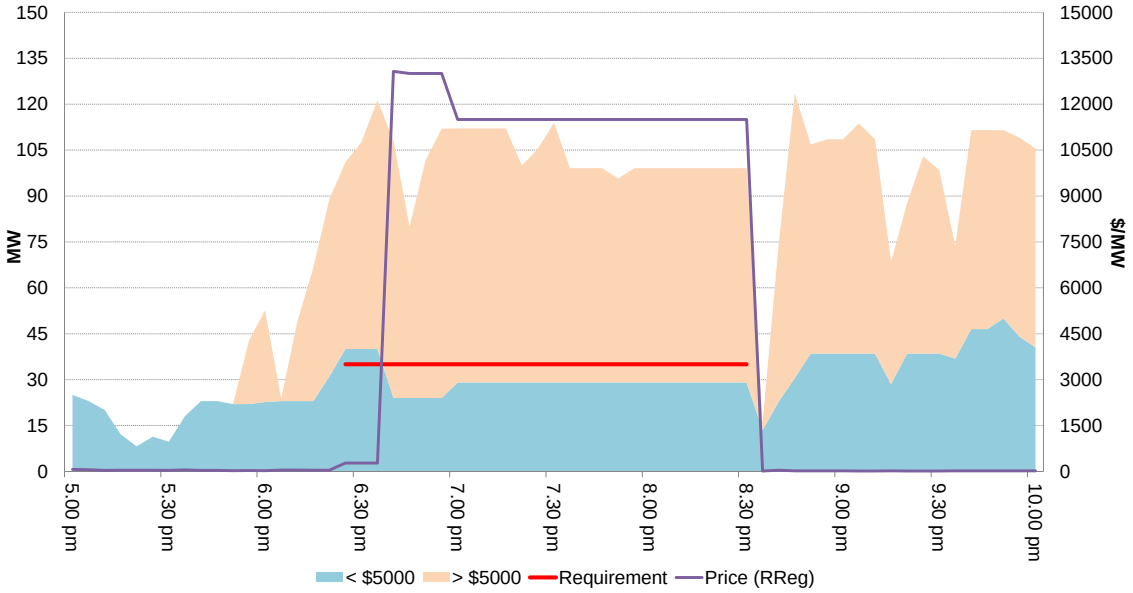


Figure 2: Raise regulation effective offers, requirement and price



3.2.2.1 Price movements from 6.45 pm

The small price movements beginning at 6.45 pm shown in Figure 1 are caused by the co-optimisation of the FCAS and Energy markets (discussed further in Box 2).

Figure 1 and Figure 2 show prices for raise and lower regulation services decrease at 7 pm. As shown in Appendix C, at 6.27 pm, effective from 6.35 pm, Origin made an additional 10 MW of raise and lower regulation services priced at $0/MW available at its Quarantine power station. However, as Quarantine's energy output was not past its minimum output required to provide FCAS at 6.35 pm (see Box 2, point a), the 10 MW was not available until 7 pm when its energy output had increased above this level. This increase in low price capacity can be seen by the increase in the shaded blue

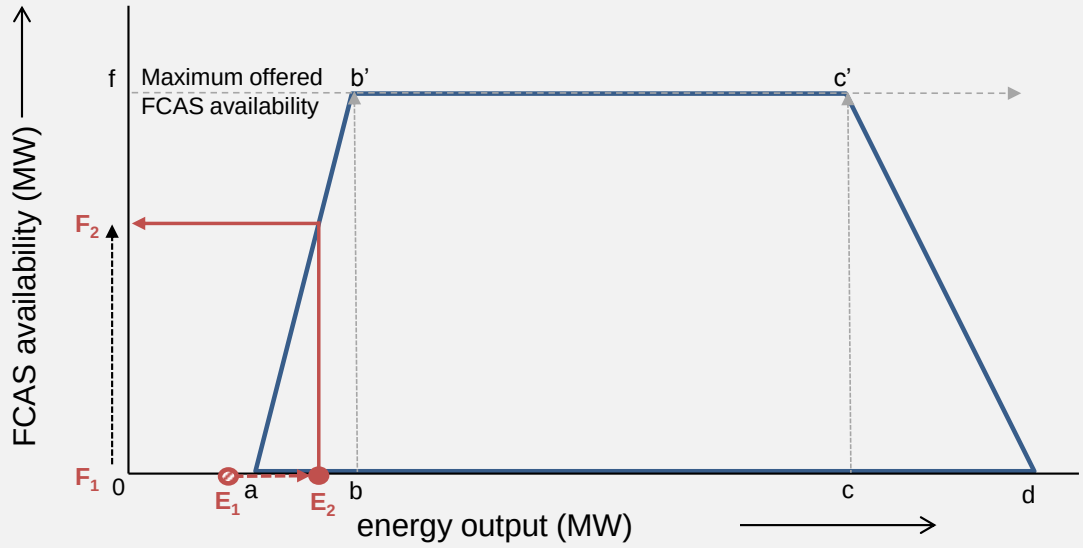
area at this time. (See Box 2 for an explanation of the relationship between FCAS availability and energy output.)

Box 2: Trade-off between generator FCAS and energy offers

Generators must register with AEMO to provide FCAS and offer FCAS capacity in a similar manner to energy into the market.

Participants offer the maximum amount of FCAS (f in the diagram below) and energy, in mega-watts (MW), they are willing to supply across ten price bands, ranging between -$1000 and $14 200 for a trading day. Trading days start at 4 am. Participants also offer the limits at which they can be dispatched in FCAS (a, b, c, d in the diagram below). The trade-off between the provision of FCAS and energy, determines the effective availability of FCAS. For example in the diagram below, if a generator's energy output is at E_1 then its effective FCAS availability is at F_1 (in this case, zero). If its output in energy increases to E_2 then its corresponding effective FCAS availability rises to F_2.

For every dispatch interval the National Electricity Market Dispatch Engine (NEMDE) co-optimises market participants FCAS and energy offers to arrive at the least cost outcome while maintaining system security.



Australian Energy Regulator

January 2018

Appendix A: Explanation of FCAS

Frequency control ancillary services (FCAS) are required to maintain the frequency of the power system within the frequency operating standards. The two general categories of FCAS are:

- Regulation services, which continuously adjust to small changes in demand or supply (changes that cause the frequency to move by only a small amount away from 50 Hz). There are regulation services to increase the frequency (raise regulation or RREG) and services to decrease the frequency (lower regulation or LREG).
- Contingency services, which manage large changes in demand or supply that occur relatively rarely and move the frequency by a large amount. There are three contingency services to increase the frequency and three contingency services to decrease the frequency. Raise contingency FCAS are required to be available to correct frequency excursions that have arisen from a credible contingency event that leads to a decrease in frequency. As these contingency events usually involve step reductions in supply side, the Electricity Rules stipulate that generators pay for these services. Lower contingency FCAS are the services required to be available to correct the frequency excursions that arise from a credible contingency event that leads to an increase in frequency. As these contingency events usually involve step reductions in customer demand, the Electricity Rules stipulate that customers pay for these services.

Participants providing regulation services receive adjusted dispatch targets every 5 minutes via their automatic generation control (AGC) signals from AEMO. Participants are paid through the FCAS markets in accordance with their offered volumes. Their energy production, which may be higher or lower depending on the AGC signals they receive, are settled in accordance with energy market prices.

There are three lower and three raise contingency services:

- fast services, which arrest a frequency deviation within the first six seconds of a contingent event (L6 and R6);
- slow services, which stabilise frequency deviations within sixty seconds of the event (L60/R60); and
- delayed services, which stabilise frequency deviations within five minutes of the event (L5/R5).

Participants offering to provide contingency services are enabled in accordance with the “trapezium” supplied in their offers. While participants will not necessarily be supplying these services until a contingency occurs they are paid in accordance with their enablement.

Frequency Control Ancillary Service Settlement

AEMO settles the FCAS markets on a weekly basis, as follows[2].

- Regulation FCAS: Cost recovery on a "causer pays" basis using the Causer Pays Procedure[3] developed by AEMO in accordance with the appropriate NER procedures.
- Contingency FCAS: Generators pay for Raise Services and customers pay for Lower Services.

The 'Causer Pays' Procedure allocates regulation FCAS costs to those market generators, customers and small generation aggregators with facilities that have the metering capable of determining their contribution to frequency deviations at any time.

Every four weeks based on historical data AEMO calculates a causer pays contribution factor for each generator. Broadly, the contribution factor is determined from historical 4 second generator output and frequency information and is a measure of how each generator contributed to managing changes in the system frequency. If a generators' output changes such that it supports maintaining the system frequency its contribution factor is positive. Conversely, if a generators' output changes such that it exacerbates a frequency deviation, its contribution factor will be negative. The causer pays contribution factors for a portfolio of generators effectively represent the aggregation of the individual performance of the generators in that portfolio.

Settlement is determined by allocating the FCAS costs incurred in the current period in accordance with the causer pays contribution factor for that portfolio from the preceding period. Thus cost allocation to a participant is not dependent on the amount of energy purchased or consumed in that period but by the performance of that participant in managing system frequency in the previous period.

Consequently a portfolio of generators with a negative factor in a particular period will still pay a share of FCAS costs irrespective of how much it generates in the current period.

Since not all of the costs will be recovered from generators, the residual costs are recovered from market customers (including retailers) in the relevant region, based on the amount of energy each market customer is purchasing.

2 For a full description go to https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Data/Ancillary-Services/Ancillary-Services-Payments-and-Recovery

3 For a full description go to https://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Security-and-reliability/Ancillary-services/Ancillary-services-causer-pays-contribution-factors

Appendix B: Local Frequency Control Ancillary Services

AEMO sets the requirement for FCAS to ensure that the frequency standard (as set by the Reliability Panel) is maintained in the event of step changes in supply or demand that results from credible contingencies. Where a credible contingency results in the loss of an interconnector it is termed a “separation event”.

The standard states that in the event of a “separation event” the frequency must be contained within 49 to 51 Hz or a wider band notified to AEMO by a relevant JSSC. In the case of South Australia the JSSC notified AEMO that the frequency band for separation of the South Australian power system is 47 to 52 Hz and that under frequency relays will operate at frequency levels in the low end of this range.

When there is a potential separation event caused by the loss of an interconnector “local frequency control ancillary services” are usually required.

If the region was exporting at the time the interconnector fails, then as a consequence of the immediate over supply situation local contingency “lower” services are required in the islanded region to lower the frequency (typically generators offer to quickly reduce output to lower frequency). In other words, the loss of the Heywood interconnector when power is flowing from South Australia, results in an oversupply of generation, increasing the frequency in South Australia. Contingency lower services are sourced from registered suppliers in South Australia (typically generators) in proportion to the flow across the interconnector from South Australia to Victoria to quickly reduce that over frequency.

A similar situation exists for contingency “raise” services for all other regions except South Australia where, in accordance with the advice from the JSSC, the raise requirement is covered by under frequency load shedding. In other words, the loss of the Heywood interconnector when power is flowing into South Australia, results in an undersupply of generation decreasing the frequency in South Australia. Under frequency load shedding reduces demand in blocks to arrest the falling frequency until supply matches demand and the frequency is restored.

In either event, in the past, in the period immediately following the separation event AEMO would invoke local regulation services and establish a local regulation reference source to manage frequency until the region can be reconnected to the rest of the NEM. It is this aspect that has been recently changed by AEMO. AEMO will now impose a requirement for local lower and raise regulation services in South Australia prior to the failure of the interconnector so that frequency after an island is formed, and after the contingency services have operated, can be smoothly maintained.

Appendix C: Significant Rebids

The rebidding tables highlight the relevant rebids submitted by generators that impacted on market outcomes during the time of high prices. It details the time the rebid was submitted and used by the dispatch process, the capacity involved, the change in the price of the capacity was being offered and the rebid reason.

Table C 1: Significant rebids for 24 October – lower regulation

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MW)	Price to ($/MW)	Rebid reason
6.27 pm	6.35 pm	Origin	Quarantine	10	n/a	0	1820A constraint management - F_ESTN++HYMO_L60 SL

Table C 2: Significant rebids for 24 October – raise regulation

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from ($/MW)	Price to ($/MW)	Rebid reason
6.27 pm	6.35 pm	Origin	Quarantine	10	n/a	0	1820A constraint management - F_ESTN++HYMO_L60 SL
6.33 pm	6.40 pm	AGL	Torrens Island	16	<15	>11 499	1825~F~070 chg in ic operation~heywood outage - V_HYMO

Appendix D: Closing bids

Figures D1a to D6b highlight for each dispatch interval the lower and raise regulation services closing bids for Origin, AGL and Engie (the participants in South Australia with ancillary service capability). It also shows the dispatch level of the respective services at each station and the dispatch price.

FCAS services are co-optimised with energy offers. For example a generator that is operating at its maximum capacity cannot provide raise services so their effective available capacity for raise services would be zero. Figures denoted with an "a" refer to the quantities offered while those with a "b" refer to the *effective* quantities available to the market after accounting for the interaction between energy and FCAS ("effective available capacity").

Lower Regulation

Figure D1a: Torrens Island (AGL) lower regulation service closing bid prices, dispatch and dispatch price - maximum offers

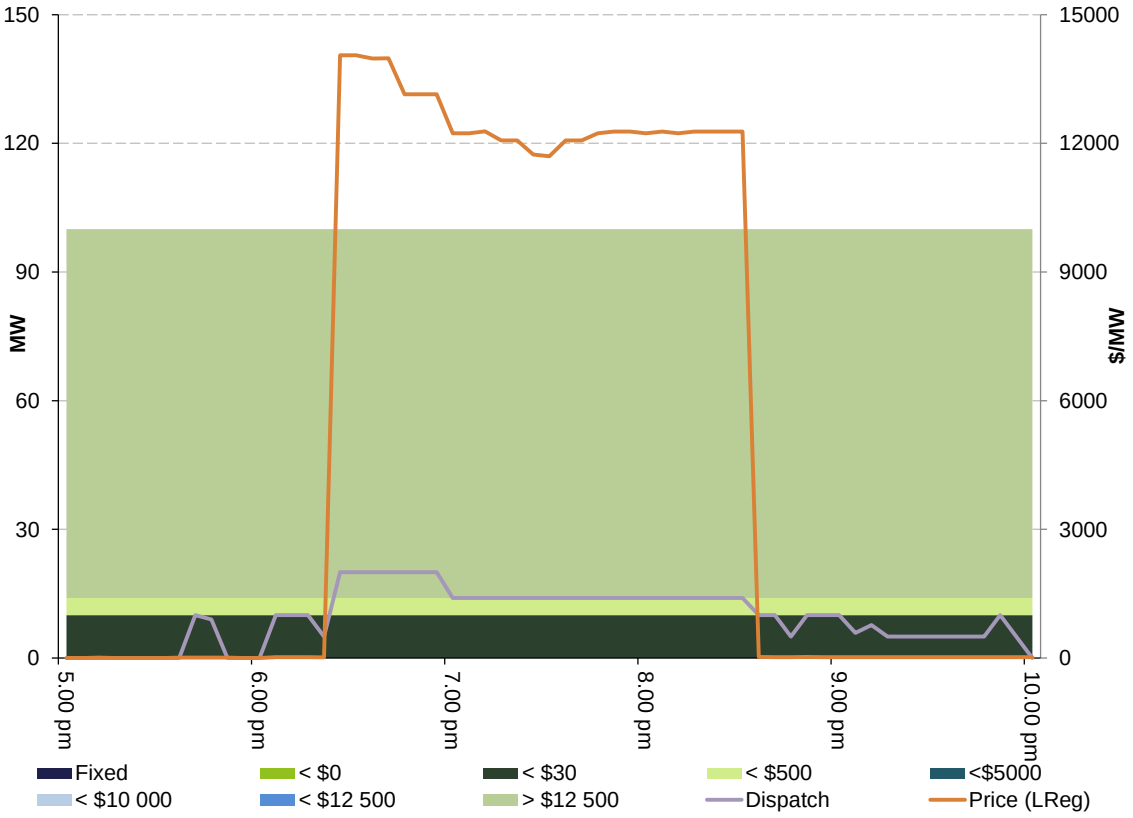


Figure D1b: Torrens Island (AGL) lower regulation service closing bid prices, dispatch and dispatch price – effective offers

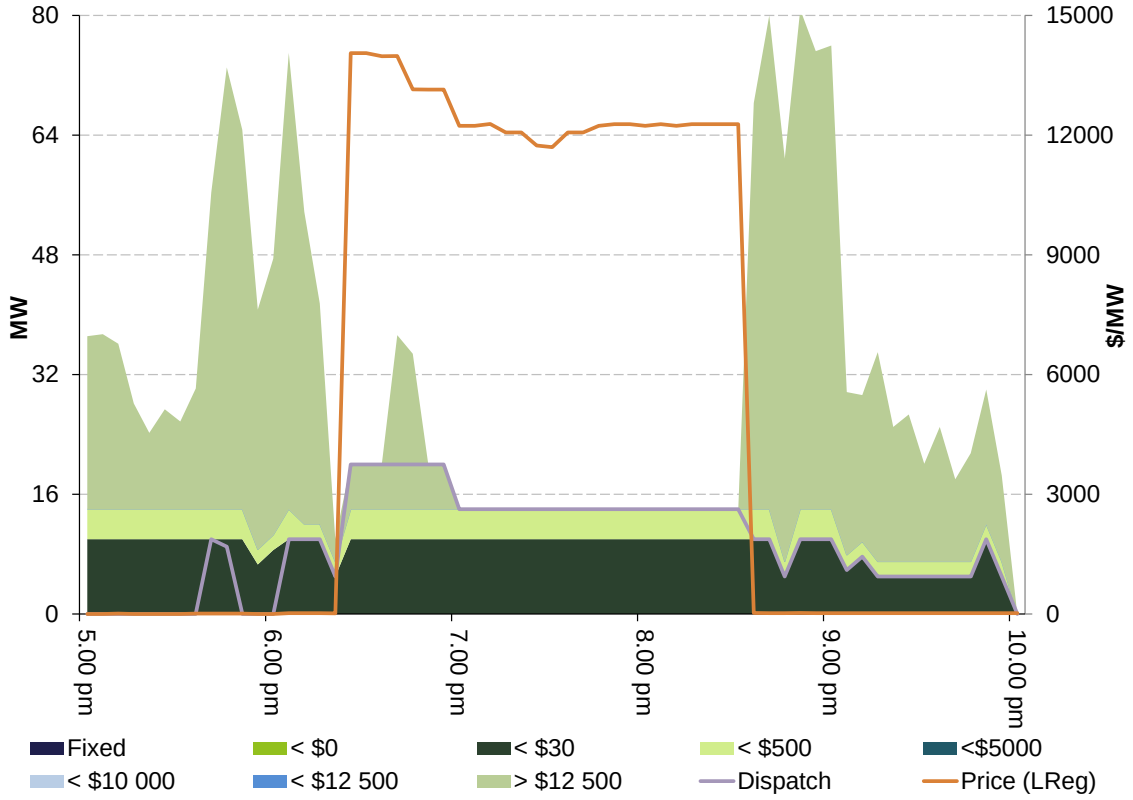


Figure D2a: Pelican Point (Engie) lower regulation service closing bid prices, dispatch and dispatch price – maximum offers

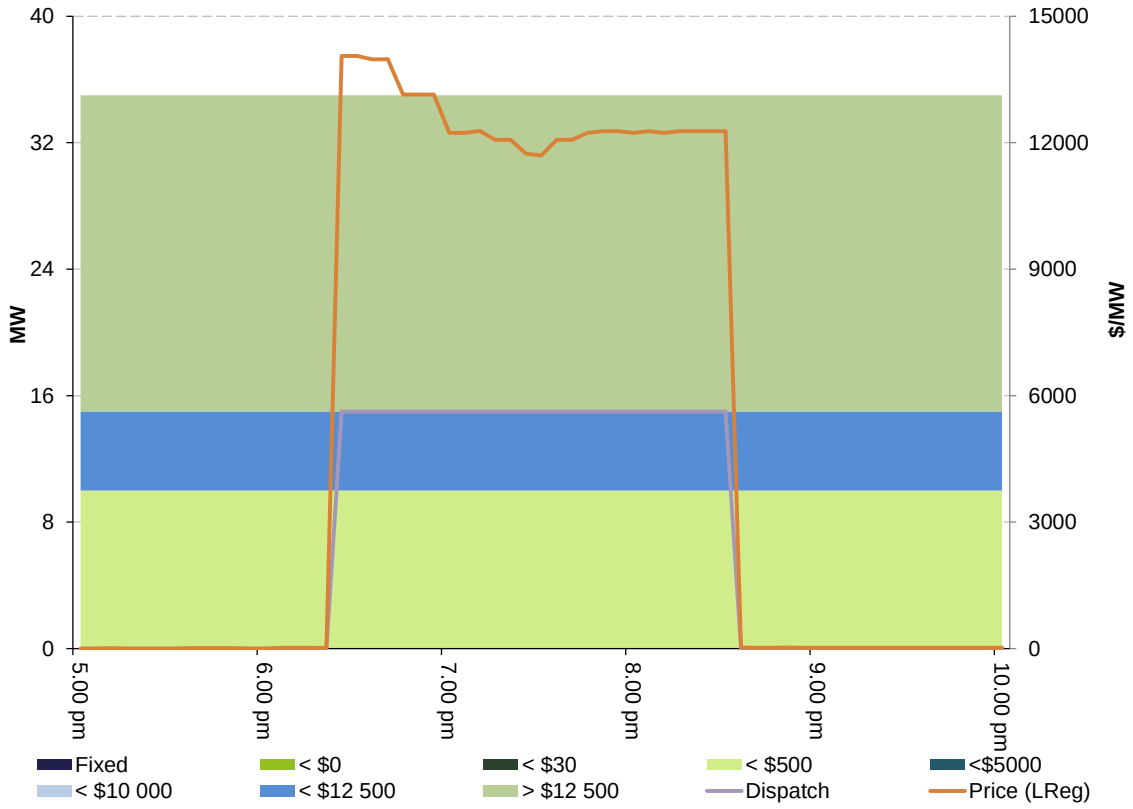


Figure D2b: Pelican Point (Engie) lower regulation service closing bid prices, dispatch and dispatch price – effective offers

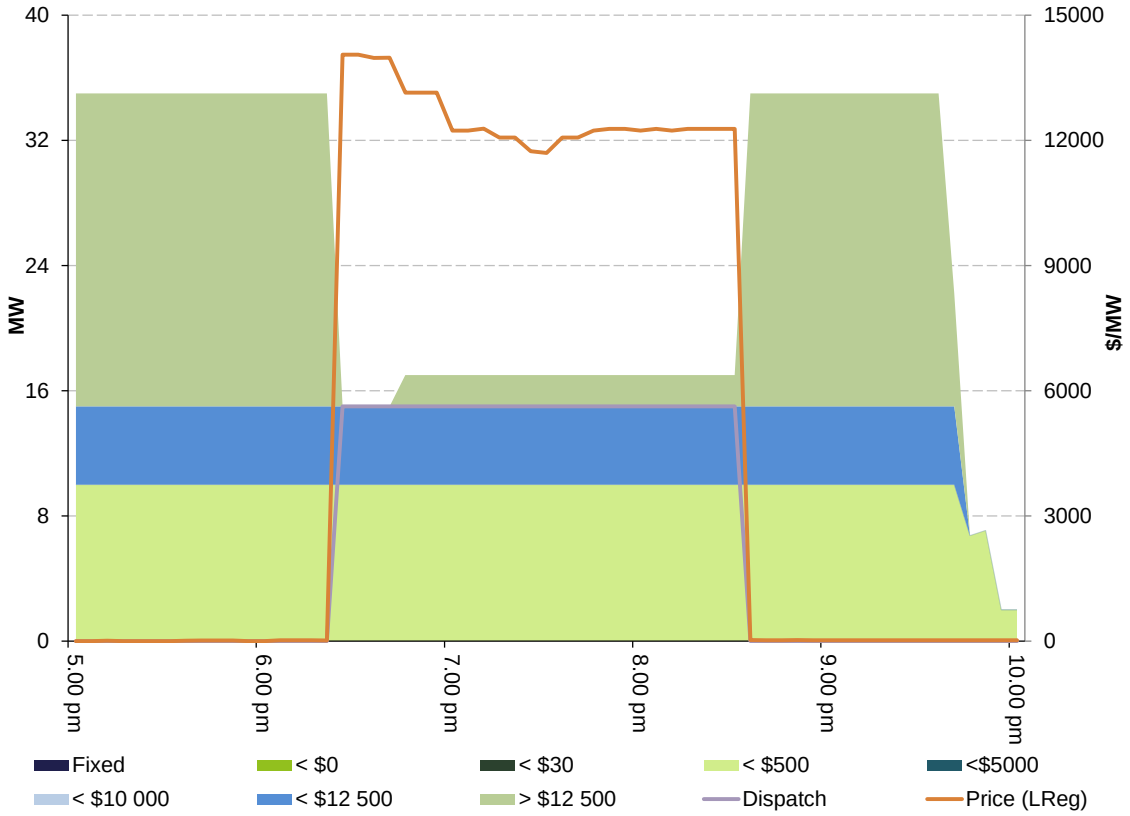


Figure D3a: Quarantine (Origin) lower regulation service closing bid prices, dispatch and dispatch price – maximum offers

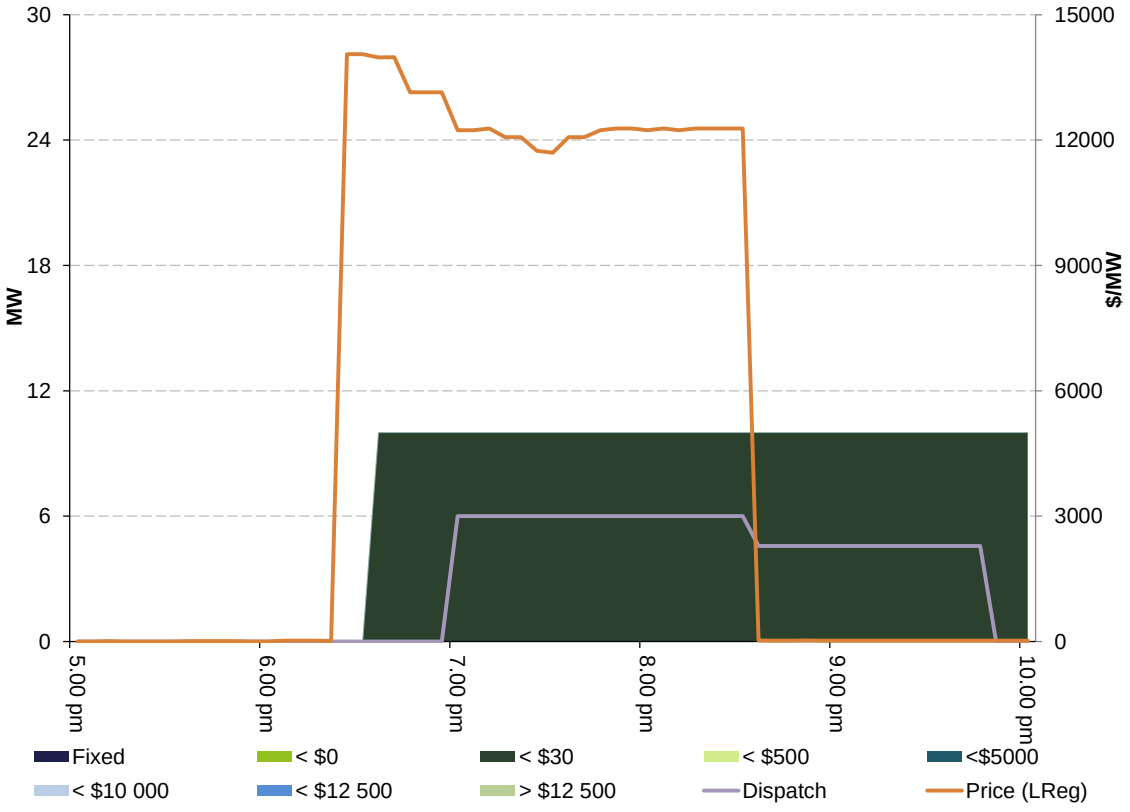
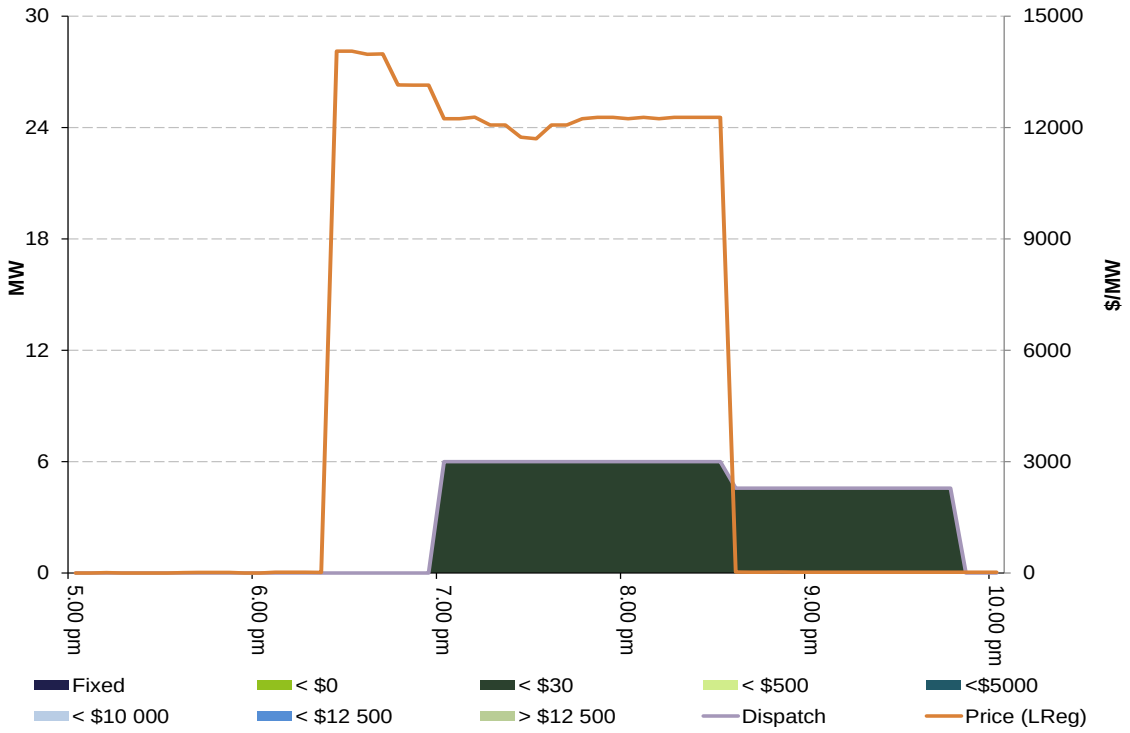


Figure D3b: Quarantine (Origin) lower regulation service closing bid prices, dispatch and dispatch price – effective offers



Raise Regulation

Figure D4a: Torrens Island (AGL) raise regulation service closing bid prices, dispatch and dispatch price - maximum offers

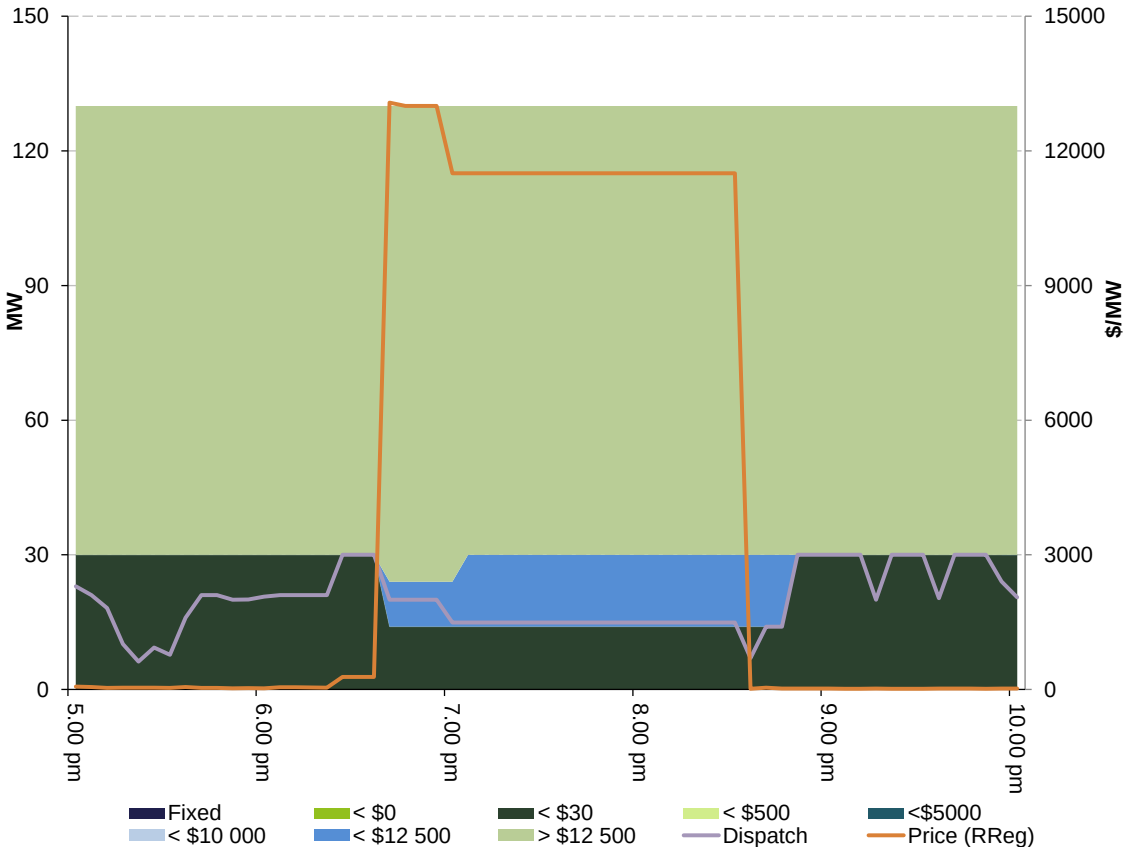


Figure D4b: Torrens Island (AGL) raise regulation service closing bid prices, dispatch and dispatch price - effective offers

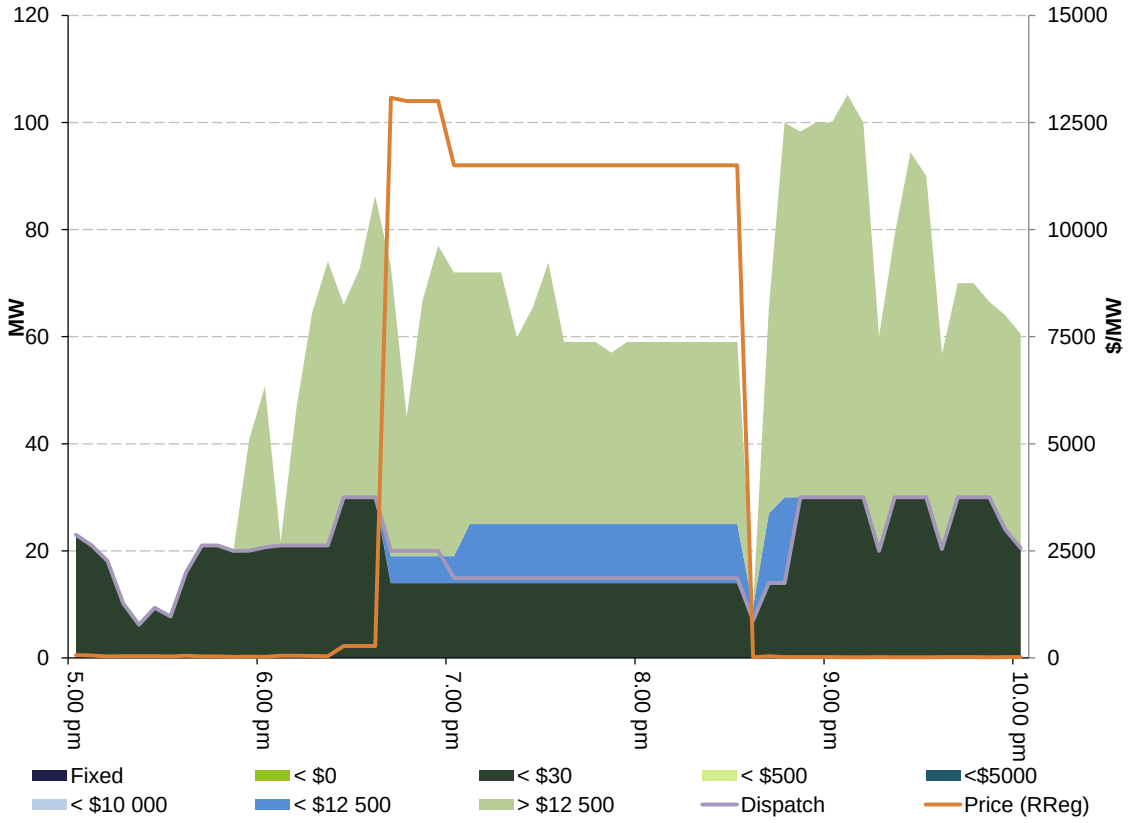


Figure D5a: Pelican Point (Engie) raise regulation service closing bid prices, dispatch and dispatch price – maximum offers

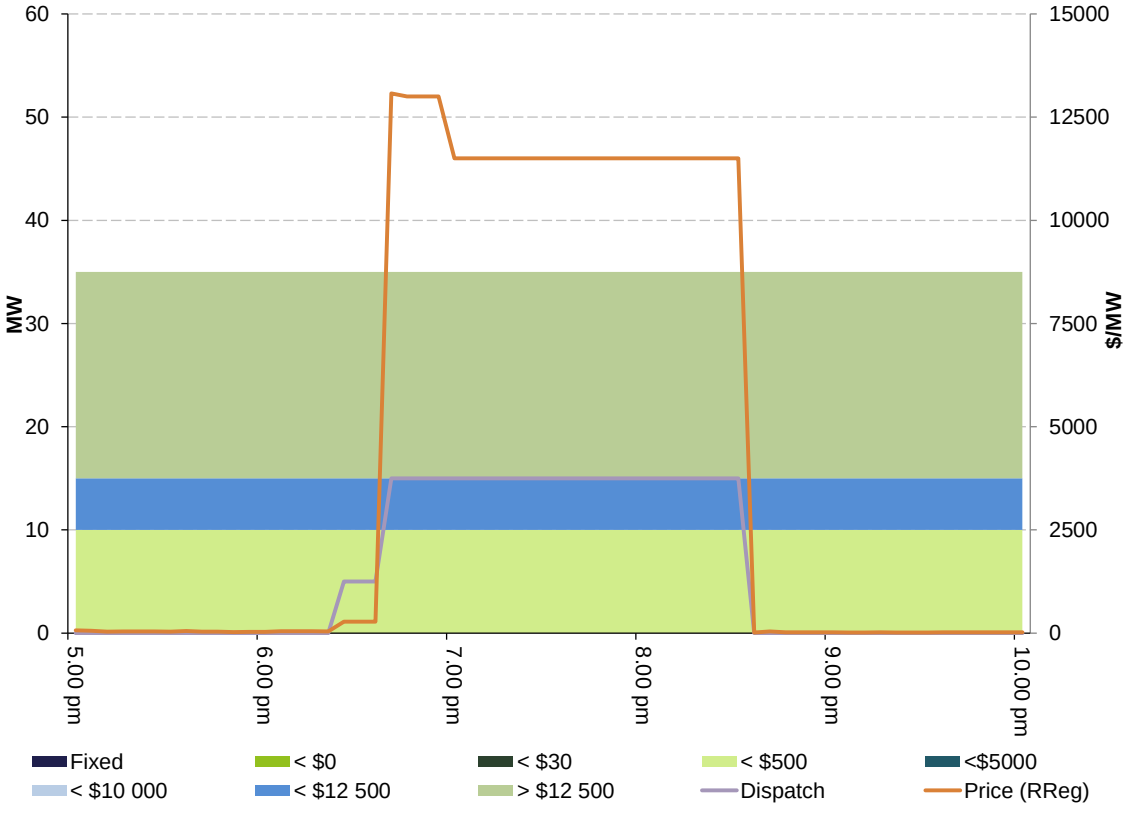


Figure D5b: Pelican Point (Engie) raise regulation service closing bid prices, dispatch and dispatch price – effective offers

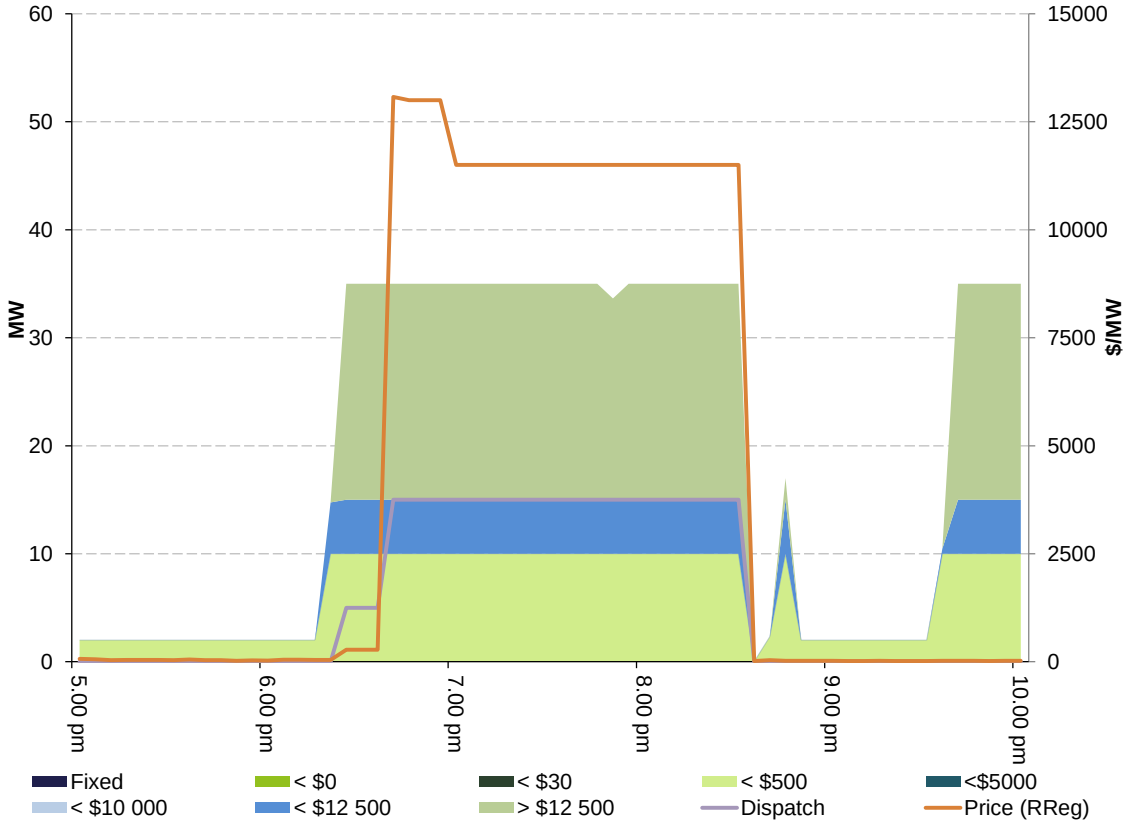


Figure D6a: Quarantine (Origin) raise regulation service closing bid prices, dispatch and dispatch price – maximum offers

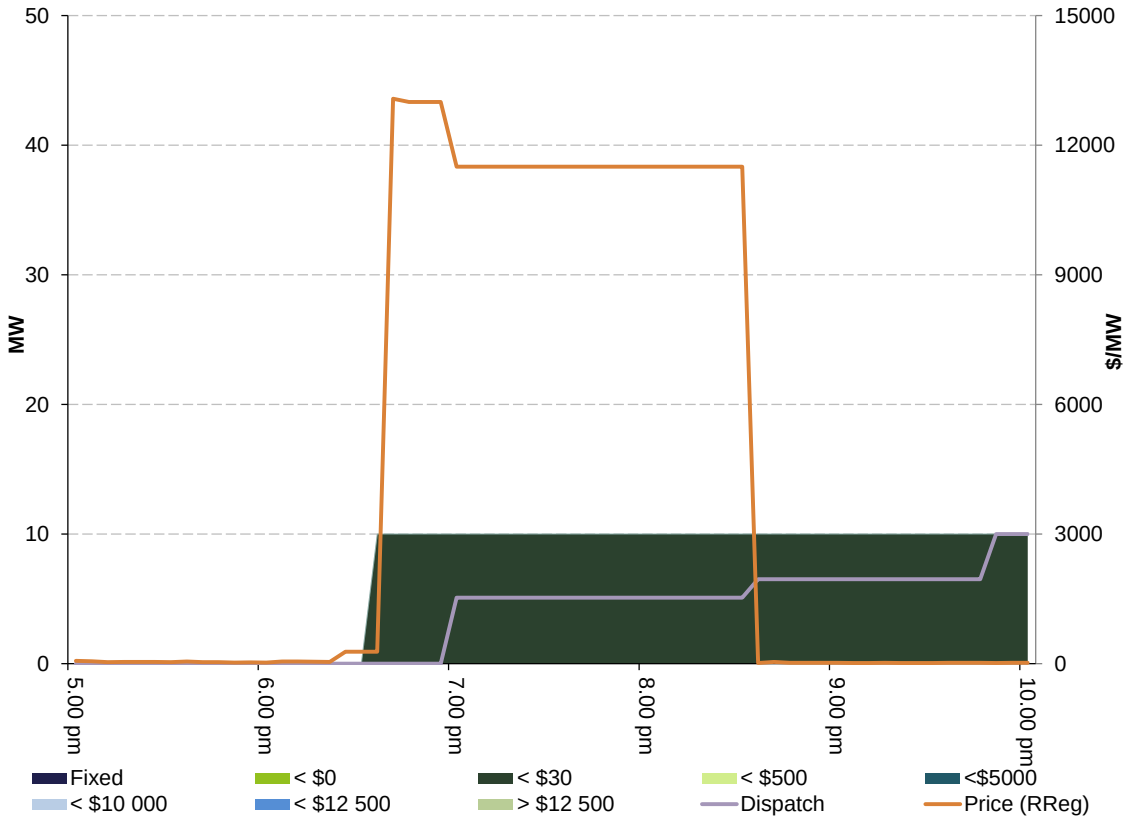
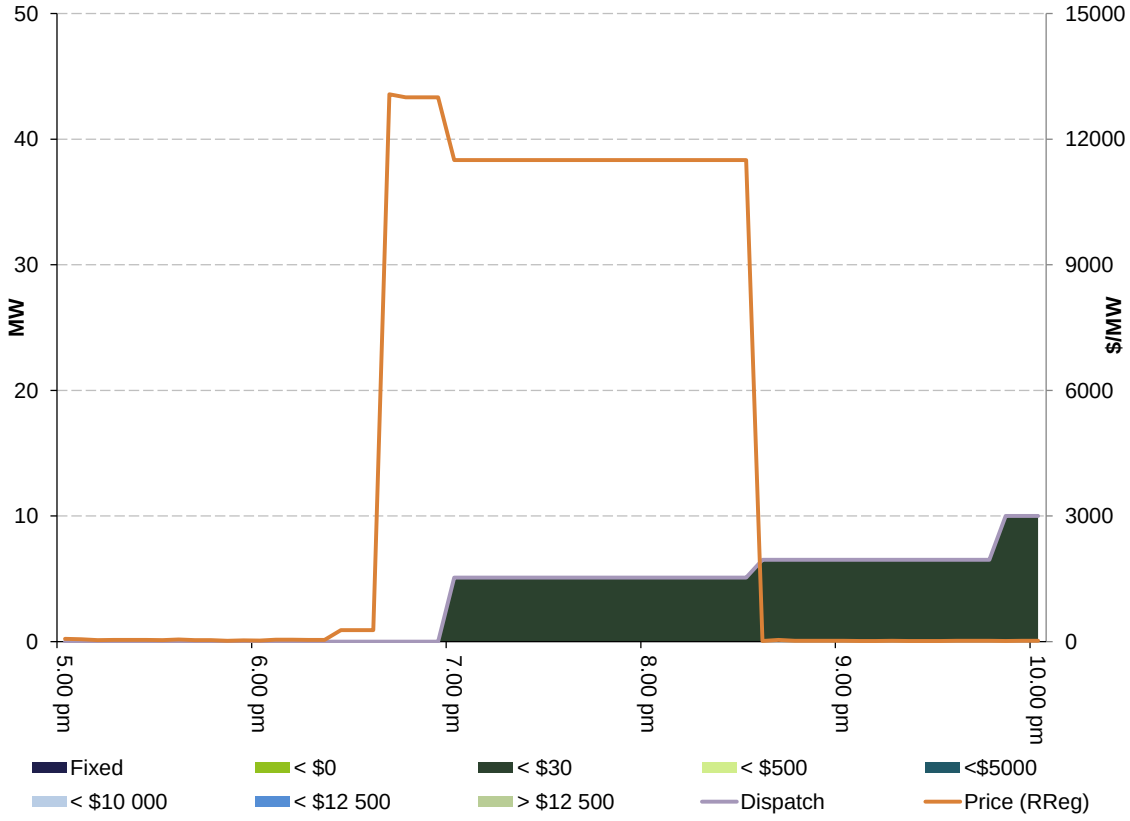


Figure D6b: Quarantine (Origin) raise regulation service closing bid prices, dispatch and dispatch price – effective offers



Appendix E: Market Notices

AEMO issued the following market notices relating to events on the day.

Market Notice	Type	Date of issue	Last Changed
59594	INTER-REGIONAL TRANSFER	24/10/2017 18:26:28	24/10/2017 18:26:28

Reason

AEMO ELECTRICITY MARKET NOTICE

At 18:12 hrs there was an unplanned outage of the Heywood - Mortlake - APD No. 2 500 kV Line.

The following constraint sets were invoked at 1820 hrs 24/10/17

V-HYMO

S-X_BC_CP

F-V-HYMO

These constraint sets contain equations with the following interconnectors on the LHS.

NSW1-QLD1

V-S-MNSP1

V-SA

VIC1-NSW1

T-V-MNSP1

Refer to AEMO Network Outage Schedule for further details.

Manager NEM Real Time Operations

Market Notice	Type	Date of issue	Last Changed
59599	INTER-REGIONAL TRANSFER	24/10/2017 20:38:15	24/10/2017 20:38:15

Reason

AEMO ELECTRICITY MARKET NOTICE

Refer AEMO Electricity Market Notice 59594.

At 20:18 hrs the Heywood - Mortlake No. 2 500 kV Line section was returned to service.

The following constraint sets were revoked at 2030 hrs 24/10/17

V-HYMO

S-X_BC_CP

F-V-HYMO

These constraint sets contain equations with the following interconnectors on the LHS.

NSW1-QLD1

V-S-MNSP1

V-SA

VIC1-NSW1

T-V-MNSP1

Refer to AEMO Network Outage Schedule for further details.

Manager NEM Real Time Operations

Appendix F: Price setter

The following tables identify for each five-minute dispatch interval where regulation dispatch prices were above $5000/MW, the price and the generating units involved in setting the price for each of the lower and raise regulation services in South Australia. This information is published by AEMO.[4] Also shown are the offer prices involved in determining the dispatch price, together with the quantity of that service and the contribution to the total price. AEMO reports an increase as a negative marginal change in FCAS price setter. Generator offers which contributed zero to the price have been removed for clarity.

Lower regulation 24 October

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
18:25	$14 055.99	AGL (SA)	TORRA2	Lower reg	$13 000.99	-0.50	-$6500.50
		AGL (SA)	TORRA4	Lower reg	$13 000.99	-0.50	-$6500.50
		AGL (SA)	TORRA2	Energy	$55.00	-0.50	-$27.50
		AGL (SA)	TORRA4	Energy	$55.00	-0.50	-$27.50
		Origin Energy	LADBROK1	Energy	-$1000.00	0.10	-$100.00
		Origin Energy	LADBROK2	Energy	-$1000.00	0.10	-$100.00
		Pacific Hydro	CLEMGPWF	Energy	-$1000.00	0.11	-$110.00
		AGL (SA)	BLUFF1	Energy	-$1000.00	0.10	-$100.00
		AGL (SA)	HALLWF1	Energy	-$1000.00	0.19	-$190.00
		AGL (SA)	HALLWF2	Energy	-$1000.00	0.14	-$140.00
		Roaring 40s	WATERLWF	Energy	-$1000.00	0.26	-$260.00
18:30	$14 055.99	AGL (SA)	TORRA2	Lower reg	$13 000.99	-0.50	-$6500.50
		AGL (SA)	TORRA4	Lower reg	$13 000.99	-0.50	-$6500.50
		AGL (SA)	TORRA2	Energy	$55.00	-0.50	-$27.50
		AGL (SA)	TORRA4	Energy	$55.00	-0.50	-$27.50
		Origin Energy	LADBROK1	Energy	-$1000.00	0.06	-$60.00
		Origin Energy	LADBROK2	Energy	-$1000.00	0.06	-$60.00
		Origin Energy	QPS5	Energy	-$1000.00	0.09	-$90.00
		Pacific Hydro	CLEMGPWF	Energy	-$1000.00	0.07	-$70.00
		Trust Power	SNOWSTH1	Energy	-$1000.00	0.16	-$160.00
		Trust Power	SNOWTWN1	Energy	-$1000.00	0.12	-$120.00
		AGL (SA)	BLUFF1	Energy	-$1000.00	0.07	-$70.00

[4] Details on how the price is determined can be found at www.aemo.com.au

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
		AGL (SA)	HALLWF1	Energy	-$1000.00	0.12	-$120.00
		AGL (SA)	HALLWF2	Energy	-$1000.00	0.09	-$90.00
		AGL (SA)	NBHWF1	Energy	-$1000.00	0.16	-$160.00
18:35	$13 975.99	AGL (SA)	TORRA2	Lower reg	$13 000.99	-1.00	-$13 000.99
		Snowy Hydro	MURRAY	Energy	$110.00	-0.83	-$91.30
		CS Energy	GSTONE2	Energy	$73.72	-0.50	-$36.86
		CS Energy	GSTONE6	Energy	$73.72	-0.50	-$36.86
		Stanwell	STAN-1	Energy	$64.99	0.50	$32.50
		Stanwell	STAN-2	Energy	$64.99	0.50	$32.50
		Stanwell	STAN-1	Raise reg	$34.00	0.50	$17.00
		Stanwell	STAN-1	Raise 6 sec	$34.00	-1.00	-$34.00
		Stanwell	STAN-2	Raise reg	$34.00	-0.50	-$17.00
		Hydro Tasmania	TUNGATIN	Raise 60 sec	$14.75	-1.00	-$14.75
		AGL (SA)	TORRA2	Raise 6 sec	$0.50	1.00	$0.50
		AGL (SA)	TORRA2	Raise 60 sec	$0.04	1.00	$0.04
		AGL (SA)	TORRA2	Lower 60 sec	$0.03	1.00	$0.03
		AGL (SA)	TORRA2	Lower 6 sec	$0.03	1.00	$0.03
		AGL (SA)	TORRB3	Lower 60 sec	$0.03	-0.17	-$0.01
		Origin Energy	LADBROK1	Energy	-$1000.00	0.04	-$40.00
		Origin Energy	LADBROK2	Energy	-$1000.00	0.04	-$40.00
		Origin Energy	QPS5	Energy	-$1000.00	0.06	-$60.00
		Pacific Hydro	CLEMGPWF	Energy	-$1000.00	0.04	-$40.00
		Hornsdale	HDWF1	Energy	-$1000.00	0.08	-$80.00
		Trust Power	SNOWNTH1	Energy	-$1000.00	0.11	-$110.00
		Trust Power	SNOWSTH1	Energy	-$1000.00	0.10	-$100.00
		Trust Power	SNOWTWN1	Energy	-$1000.00	0.08	-$80.00
		AGL (SA)	BLUFF1	Energy	-$1000.00	0.04	-$40.00
		AGL (SA)	HALLWF1	Energy	-$1000.00	0.07	-$70.00
		AGL (SA)	HALLWF2	Energy	-$1000.00	0.06	-$60.00
		AGL (SA)	NBHWF1	Energy	-$1000.00	0.10	-$100.00
18:40	$13 981.84	AGL (SA)	TORRA2	Lower reg	$13 000.99	-1.00	-$13 000.99

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
		Snowy Hydro	MURRAY	Energy	$110.00	-0.83	-$91.30
		AGL Energy	BW04	Raise 6 sec	$48.00	-1.00	-$48.00
		Hydro Tasmania	TUNGATIN	Raise 60 sec	$14.75	-1.00	-$14.75
		AGL (SA)	TORRB3	Lower 60 sec	$0.03	-0.17	-$0.01
		Hydro Tasmania	POAT220	Lower 60 sec	$0.01	-0.83	-$0.01
		Hydro Tasmania	POAT220	Lower 6 sec	$0.01	-1.00	-$0.01
		Origin Energy	LADBROK1	Energy	-$1000.00	0.04	-$40.00
		Origin Energy	LADBROK2	Energy	-$1000.00	0.04	-$40.00
		Origin Energy	QPS5	Energy	-$1000.00	0.05	-$50.00
		Pacific Hydro	CLEMGPWF	Energy	-$1000.00	0.04	-$40.00
		Hornsdale	HDWF1	Energy	-$1000.00	0.08	-$80.00
		Trust Power	SNOWNTH1	Energy	-$1000.00	0.11	-$110.00
		Trust Power	SNOWSTH1	Energy	-$1000.00	0.09	-$90.00
		Trust Power	SNOWTWN1	Energy	-$1000.00	0.07	-$70.00
		AGL (SA)	BLUFF1	Energy	-$1000.00	0.04	-$40.00
		AGL (SA)	NBHWF1	Energy	-$1000.00	0.10	-$100.00
		AGL (SA)	TORRA4	Energy	-$1000.00	0.03	-$30.00
		AGL (SA)	TORRB4	Energy	-$1000.00	0.14	-$140.00
18:45	$13 145.38	AGL (SA)	TORRA2	Lower reg	$13 000.99	-1.00	-$13 000.99
		AGL (SA)	TORRA2	Energy	$55.00	-1.00	-$55.00
		AGL (SA)	HALLWF1	Energy	-$89.39	1.00	-$89.39
18:50	$13 145.21	AGL (SA)	TORRA2	Lower reg	$13 000.99	-1.00	-$13 000.99
		AGL (SA)	TORRA2	Energy	$55.00	-1.00	-$55.00
		AGL (SA)	NBHWF1	Energy	-$89.22	1.00	-$89.22
18:55	$13 145.21	AGL (SA)	TORRA2	Lower reg	$13 000.99	-1.00	-$13 000.99
		AGL (SA)	TORRA2	Energy	$55.00	-1.00	-$55.00
		AGL (SA)	NBHWF1	Energy	-$89.22	1.00	-$89.22
19:00	$12 236.08	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
			HDWF3	Energy	-$80.00	4.60	-$368.00
19:05	$12 236.08	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
			HDWF3	Energy	-$80.00	4.60	-$368.00
19:10	$12 278.49	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	NBHWF1	Energy	-$89.22	4.60	-$410.41
19:15	$12 068.64	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	NBHWF1	Energy	-$43.60	4.60	-$200.56
19:20	$12 068.64	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	NBHWF1	Energy	-$43.60	4.60	-$200.56
19:25	$11 740.70	AGL (SA)	TORRB3	Raise reg	$11 499.99	-1.00	-$11 499.99
		Hydro Tasmania	LEM_WIL	Energy	$92.43	-1.81	-$167.30
		CS Energy	GSTONE2	Energy	$83.73	-3.38	-$283.01
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	ER01	Energy	$74.97	1.53	$114.70
		Origin Energy	ER02	Energy	$74.97	1.53	$114.70
		Origin Energy	ER04	Energy	$74.97	1.53	$114.70
		AGL (SA)	TORRB3	Energy	$55.00	2.30	$126.50
		AGL (SA)	TORRB4	Energy	$55.00	2.30	$126.50
		CS Energy	GSTONE2	Raise 6 sec	$20.69	3.38	$69.93
		Hydro Tasmania	LEM_WIL	Raise 6 sec	$20.50	0.05	$1.03

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
		Hydro Tasmania	GORDON	Raise 6 sec	$17.00	-3.43	-$58.31
		Hydro Tasmania	TRIBUTE	Raise 60 sec	$14.75	-1.72	-$25.37
		CS Energy	GSTONE2	Raise 60	$14.74	3.38	$49.82
		Hydro Tasmania	GORDON	Raise 60 sec	$8.95	-7.94	-$71.06
		AGL (SA)	TORRB3	Raise 60 sec	$5.00	3.14	$15.70
		AGL (SA)	TORRB4	Raise 60 sec	$5.00	3.14	$15.70
		Origin Energy	ER01	Raise reg	$2.84	-1.53	-$4.35
		Origin Energy	ER02	Raise reg	$2.84	-1.53	-$4.35
		Origin Energy	ER04	Raise reg	$2.84	-1.53	-$4.35
		Hydro Tasmania	GORDON	Raise 5 min	$2.00	-4.60	-$9.20
		AGL (SA)	TORRB3	Raise 5 min	$0.90	2.30	$2.07
		AGL (SA)	TORRB4	Raise 5 min	$0.90	2.30	$2.07
		Hydro Tasmania	GORDON	Raise reg	$0.10	4.60	$0.46
			T-V-MNSP1,VIC1	Energy	$0.01	-1.70	-$0.02
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
19:30	$11 698.76	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
		Snowy Hydro	MURRAY	Energy	$110.00	-1.66	-$182.60
		CS Energy	GSTONE2	Energy	$83.73	-3.43	-$287.19
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	ER01	Energy	$74.97	1.53	$114.70
		Origin Energy	ER02	Energy	$74.97	1.53	$114.70
		Origin Energy	ER04	Energy	$74.97	1.53	$114.70
		AGL (SA)	TORRB3	Energy	$55.00	2.30	$126.50
		AGL (SA)	TORRB4	Energy	$55.00	2.30	$126.50
		CS Energy	GSTONE2	Raise 6 sec	$20.69	3.43	$70.97
		Hydro Tasmania	GORDON	Raise 6 sec	$17.00	-3.43	-$58.31
		Hydro Tasmania	TRIBUTE	Raise 60 sec	$14.75	4.51	$66.52

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
		CS Energy	GSTONE2	Raise 60 sec	$14.74	3.43	$50.56
		Hydro Tasmania	GORDON	Raise 60 sec	$8.95	-7.94	-$71.06
		Origin Energy	ER01	Raise reg	$2.84	-1.53	-$4.35
		Origin Energy	ER02	Raise reg	$2.84	-1.53	-$4.35
		Origin Energy	ER04	Raise reg	$2.84	-1.53	-$4.35
		Hydro Tasmania	GORDON	Raise 5 min	$2.00	-4.60	-$9.20
		AGL (SA)	TORRB3	Raise 5 min	$0.90	2.30	$2.07
		AGL (SA)	TORRB4	Raise 5 min	$0.90	2.30	$2.07
		Hydro Tasmania	GORDON	Raise reg	$0.10	4.60	$0.46
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
19:35	$12 068.64	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	NBHWF1	Energy	-$43.60	4.60	-$200.56
19:40	$12 068.64	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	NBHWF1	Energy	-$43.60	4.60	-$200.56
19:45	$12 236.08	AGL (SA)	TORRB3	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
			HDWF3	Energy	-$80.00	4.60	-$368.00
19:50	$12 276.19	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	BLUFF1	Energy	-$88.72	4.60	-$408.11

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
19:55	$12 276.19	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	BLUFF1	Energy	-$88.72	4.60	-$408.11
20:00	$12 236.08	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
			HDWF3	Energy	-$80.00	4.60	-$368.00
20:05	$12 276.19	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	BLUFF1	Energy	-$88.72	4.60	-$408.11
20:10	$12 236.08	AGL (SA)	TORRB3	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
			HDWF3	Energy	-$80.00	4.60	-$368.00
20:15	$12 276.19	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	BLUFF1	Energy	-$88.72	4.60	-$408.11
20:20	$12 276.19	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	BLUFF1	Energy	-$88.72	4.60	-$408.11
20:25	$12 276.19	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	BLUFF1	Energy	-$88.72	4.60	-$408.11
20:30	$12 276.19	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
		Origin Energy	QPS5	Energy	$80.02	-4.60	-$368.09
		Origin Energy	QPS5	Lower reg	$0.00	-1.00	$0.00
		Origin Energy	QPS5	Raise reg	$0.00	1.00	$0.00
		AGL (SA)	BLUFF1	Energy	-$88.72	4.60	-$408.11

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DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
18:40	$13 075.14	AGL (SA)	TORRA2	Raise reg	$13 000.99	-1.00	-$13 000.99
		Snowy Hydro	MURRAY	Energy	$110.00	0.83	$91.30
		AGL (SA)	TORRA2	Energy	$55.00	-1.00	-$55.00
		AGL Energy	BW04	Raise 6 sec	$48.00	1.00	$48.00
		Hydro Tasmania	TUNGATIN	Raise 60 sec	$14.75	1.00	$14.75
		AGL (SA)	TORRB3	Lower 60 sec	$0.03	0.17	$0.01
		Hydro Tasmania	POAT220	Lower 60 sec	$0.01	0.83	$0.01
		Hydro Tasmania	POAT220	Lower 6 sec	$0.01	1.00	$0.01
		Origin Energy	LADBROK1	Energy	-$1000.00	0.01	-$10.00
		Origin Energy	LADBROK2	Energy	-$1000.00	0.01	-$10.00
		Origin Energy	QPS5	Energy	-$1000.00	0.01	-$10.00
		Pacific Hydro	CLEMGPWF	Energy	-$1000.00	0.01	-$10.00
		Hornsdale	HDWF1	Energy	-$1000.00	0.02	-$20.00
		Trust Power	SNOWNTH1	Energy	-$1000.00	0.02	-$20.00
		Trust Power	SNOWSTH1	Energy	-$1000.00	0.02	-$20.00
		Trust Power	SNOWTWN1	Energy	-$1000.00	0.02	-$20.00
		AGL (SA)	BLUFF1	Energy	-$1000.00	0.01	-$10.00
		AGL (SA)	NBHWF1	Energy	-$1000.00	0.02	-$20.00
		AGL (SA)	TORRA4	Energy	-$1000.00	0.01	-$10.00

DI	Dispatch Price ($/MW)	Participant	Unit	Service	Offer price ($/MW)	Marginal change	Contribution
		AGL (SA)	TORRB4	Energy	-$1000.00	0.03	-$30.00
18:45	$13 000.99	AGL (SA)	TORRA2	Raise reg	$13 000.99	-1.00	-$13 000.99
18:50	$13 000.99	AGL (SA)	TORRA2	Raise reg	$13 000.99	-1.00	-$13 000.99
18:55	$13 000.99	AGL (SA)	TORRA2	Raise reg	$13 000.99	-1.00	-$13 000.99
19:00	$11 499.99	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
19:05	$11 499.99	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
19:10	$11 499.99	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
19:15	$11 499.99	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
19:20	$11 499.99	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
19:25	$11 499.99	AGL (SA)	TORRB3	Raise reg	$11 499.99	-1.00	-$11 499.99
19:30	$11 499.99	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
19:35	$11 499.99	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
19:40	$11 499.99	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
19:45	$11 499.99	AGL (SA)	TORRB3	Raise reg	$11 499.99	-1.00	-$11 499.99
19:50	$11 499.99	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
19:55	$11 499.99	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
20:00	$11 499.99	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
20:05	$11 499.99	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
20:10	$11 499.99	AGL (SA)	TORRB3	Raise reg	$11 499.99	-1.00	-$11 499.99
20:15	$11 499.99	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
20:20	$11 499.99	AGL (SA)	TORRB4	Raise reg	$11 499.99	-1.00	-$11 499.99
20:25	$11 499.99	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99
20:30	$11 499.99	AGL (SA)	TORRA2	Raise reg	$11 499.99	-1.00	-$11 499.99