



Report into Market ancillary service prices above \$5000/MW

**South Australia,
11 August 2016**

29 November 2016

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1 Introduction

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 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/MWh;
- 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/MWh.

On 11 August 2016, the price of two Frequency Control Ancillary Services (FCAS) in South Australia exceeded \$5000/MW for an extended period, significantly in excess of energy spot prices. This report presents our analysis of the events in accordance with this obligation.

2 Summary

On 11 August the local price for both lower and raise regulation frequency control regulation services (FCAS)¹ in South Australia exceeded \$5000/MW for over 90 dispatch intervals. Raise and lower regulation services are designed to maintain the frequency of the power system constant (at 50 Hertz) when small changes of demand and supply occur. The combined cost of regulation services on 11 August was in excess of \$6.6 million – these costs are borne by generators and consumers in South Australia. On the mainland, FCAS costs are typically around \$200 000 per day².

The dominant factors that led to these high prices were:

- The planned network outage in Victoria from 10 to 12 August. This outage introduced a credible risk of islanding South Australia from the National Electricity Market (NEM). When this occurs the Australian Energy Market Operator (AEMO) requires South Australia to locally source 35 MW of raise and lower regulation service to mitigate this risk. See Appendix B for a description of the local regulation requirement.
- The offers by generators in South Australia for local regulation services:
 - There were three power stations in South Australia that could provide more than 350 MW of local regulation services. Early forecasts indicated there was a minimum of 39 MW of each service offered to the market priced below \$500/MW, sufficient to cover the 35 MW requirements. The remaining capacity (up to 300 MW) was priced above \$10 000/MW.
 - Rebidding of 5 MW of capacity by Origin Energy in both regulation services into high price bands, leaving only 34 MW (below the 35 MW local requirement) of both services at low prices.

While the majority of early forecasts indicated that prices would not exceed \$100/MW, actual prices for lower and raise regulation services were around \$11 000/MW for 107 and 95 dispatch intervals respectively, exceeding the AER's \$5000/MW reporting threshold.

These sustained high prices caused the cumulative price threshold (CPT)³ to be breached at 7.25 pm, triggering an administered price period. AEMO then applied the administered price cap of \$300/MW, which remained in place until 18 August.

Over the three days of the network outage, while local regulation requirement of 35 MW was in place, the total cost of these services, was around \$7.2 million. The 35 MW local regulation requirement imposed by AEMO has cost South Australian generators and consumers around \$35 million since the constraint was invoked in October 2015.

¹ Appendix A contains a more detailed explanation of frequency control ancillary services (FCAS).

² Average costs of the 2015/2016 FY.

³ The cumulative price threshold is a price risk safety net. See section 3.4

3 Analysis

On 11 August, in response to a planned network outage in Victoria AEMO invoked local regulation FCAS requirements in South Australia. Prices for these services exceeded \$10 000/MW for most dispatch intervals from 10.35 am to 7.25 pm. This section sets out the factors which contributed to the high price outcomes.

3.1 Planned network outage

South Australia is electrically connected to Victoria by the Heywood and Murraylink interconnectors. The Heywood Interconnector is an alternating current high voltage transmission link with a nominal capacity of 460 MW, while Murraylink is a 220 MW direct current interconnector. Heywood provides synchronous connection between South Australia and the rest of the NEM.

The Heywood interconnector is currently being augmented to increase its nominal capacity to 650 MW. From time to time network outages are planned to allow work to be undertaken. When there is a network outage that risks islanding South Australia, AEMO invokes constraints requiring 35 MW of local regulation services. This ensures there are adequate sources of regulation services immediately available in a separation event to manage the frequency within the islanded region post contingency.

On 10 to 12 August there was a planned network outage on the South East to Heywood 500 kV line as part of the Heywood interconnector upgrade project. The market notice announcing the outage is replicated at Appendix E. As this outage put South Australia on a single contingency, which could result in the region being islanded, AEMO invoked the 35 MW regulation constraints for the duration of the outage.

3.2 Regulation service availability

Three power stations in South Australia were registered to provide raise and lower regulation services on the day, (shown in Table 1) each individually capable of providing the local regulation requirement.

Table 1: Registered maximum capacity by station and regulation service

Power Station	Max Capacity	
	Lower regulation	Raise regulation
Quarantine (Origin Energy) ⁴	50	50
Pelican Point (Engie)	100	100
Torrens Island (AGL)	200	260
Total	350	410

⁴ In December 2015 Origin Energy registered its Quarantine Power Station to provide 50 MW regulation services, more than offsetting the 20 MW lost when Alinta Energy decommissioned Northern Power station in May 2016.

3.3 Effective available capacity and price

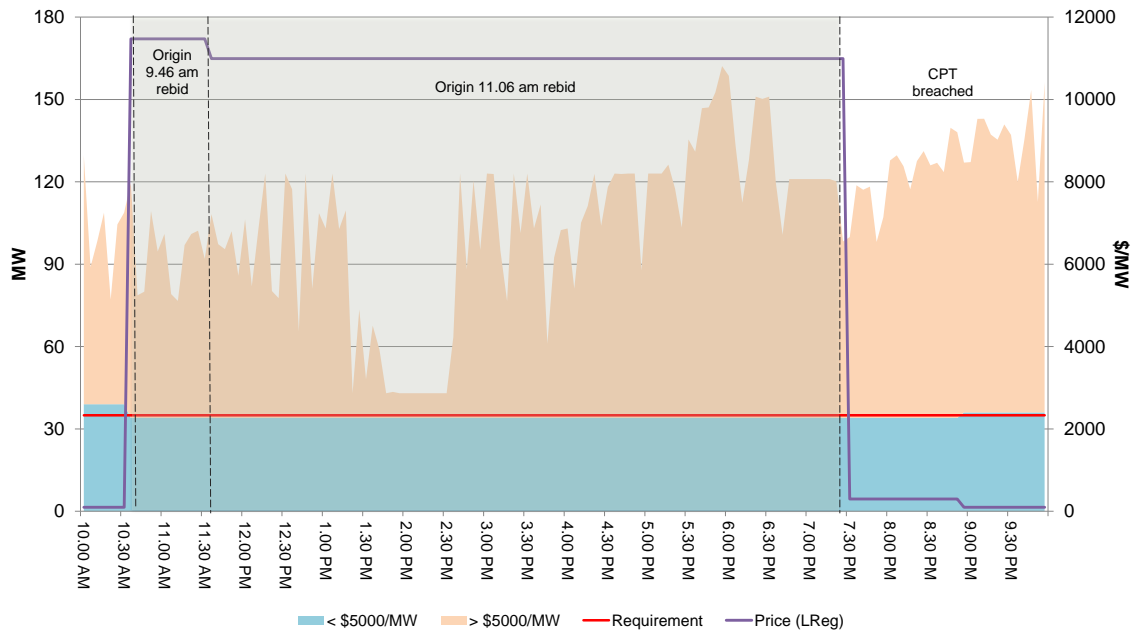
For every dispatch interval the National Electricity Market Dispatch Engine (NEMDE) co-optimises FCAS and energy offers to arrive at the least cost security constrained solution. Effective available FCAS capacity is the offered FCAS capacity adjusted for the energy output of the generator.

Prices for lower and raise regulation services were around \$11 000/MW for almost nine hours, exceeding the \$5000/MW reporting threshold for 107 and 95 dispatch intervals respectively.

Figure 1 and Figure 2 show actual price (purple line)⁵ and effective available capacity over the high price period. The (constant) 35 MW requirement is shown as a red line.

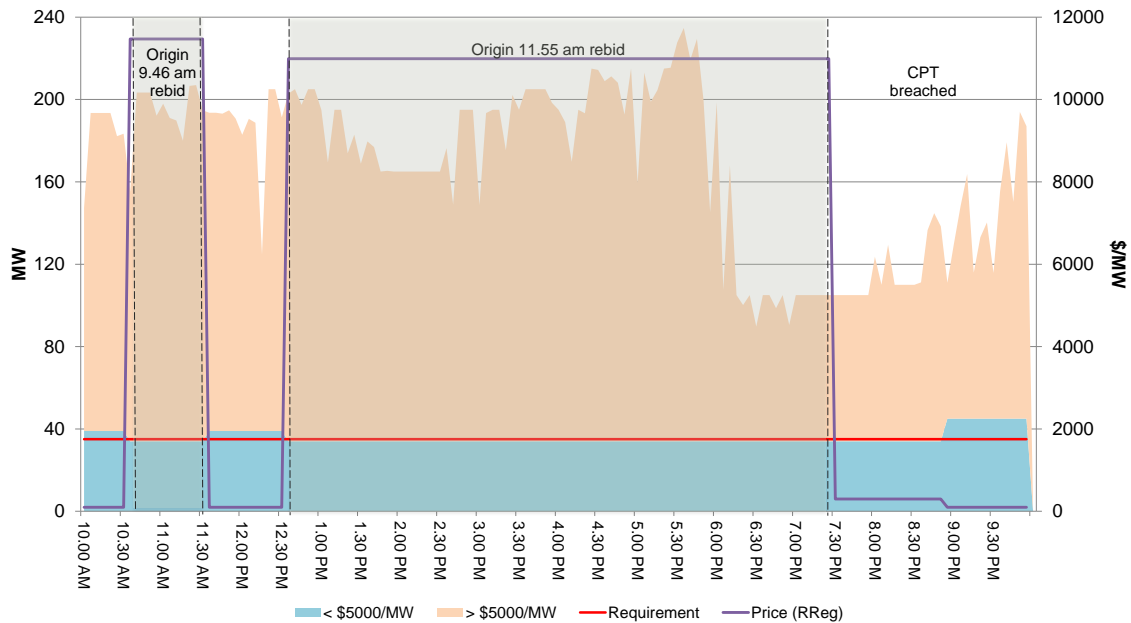
The blue shaded areas indicate effective available capacity below \$5000/MW and effective available capacity above \$5000/MW is indicated by the light orange shaded areas.

Figure 1 Lower regulation effective offers, requirement and price



⁵ Individual prices are contained in the Price Setter at Appendix F

Figure 2 Raise regulation effective offers, requirement and price



Prices for raise and lower regulation services were forecast to be below \$100/MW four and twelve hours ahead of dispatch for the majority of the high price period. Four hours ahead of dispatch, effective available capacity was forecast to be around 130 MW for lower regulation services and around 220 MW for raise regulation services (sufficient to cover the 35 MW requirement) for the high price period.

The circumstances relating to the imposition of the South Australian regulation requirement are described more fully in Appendix B.

3.3.1 Rebidding

Forecasts four and 12 hours ahead showed that the 35 MW of local requirements could be met by low price capacity. Rebidding of lower and raise regulation services by Origin Energy at its Quarantine Power Station from low prices to high prices was the dominant factor affecting the high price outcomes. All significant rebids are listed in Appendix C.

Out of 410 MW and 350 MW of capacity registered for raise and lower regulation services respectively, 260 MW and 200 MW was offered to the market. 39 MW was offered in price bands less than \$5000/MW⁶ and 222 MW and 162 MW respectively offered in bands greater than \$5000/MW.

Across the day, Origin Energy submitted three rebids that shifted regulation service capacity from \$0/MW into bands priced above \$10 000/MW.

1. At 9.46 am, effective from 10.35 am for two trading intervals, Origin Energy rebid 5 MW of lower and raise services at Quarantine from \$0/MW to \$11 900/MW and above (the reason related to a change in demand). This left only 34 MW of capacity priced below \$5000/MW; 1 MW below the 35 MW requirement. Higher cost

⁶ In fact this capacity was priced under \$500/MW.

services had to be used to meet the requirement and, consequently, the price, for both services, reached \$11 469/MW and remained there until 11.30 am, when the rebid was no longer in effect. See Figure 1 and Figure 2 to observe the effect of the 9.46 am Origin rebid.

2. At 11.06 am, effective from 11.35 am until the end of the trading day, Origin rebid 5 MW of lower regulation services at its Quarantine Power Station from \$0/MW to \$10 990/MW and above (the reason related to a change in demand), setting the price until 7.25 pm. The sustained high prices resulted in the CPT being breached at 7.25 pm and the administered price cap of \$300/MW was applied during the 7.30 pm dispatch interval (see Figure 1). The cumulative price threshold is discussed further in section 3.4.
3. At 11.55 am, effective from 12.35 pm until the end of the trading day, Origin Energy rebid 5 MW of raise regulation services at Quarantine from \$0/MW to \$10 990/MW, setting the price at \$10 990/MW until 7.25 pm (see Figure 2). The reason related to the financial optimisation of their energy and FCAS portfolio. The sustained high prices resulted in the CPT being breached at 7.30 pm, at which time the administered price cap of \$300/MW was applied.

Figure 1 and Figure 2 show the effect of Origin Energy's rebidding at Quarantine Power Station. The rebidding reduced the amount of low price capacity (shown by the light blue shaded area), which meant the 35 MW requirement (shown by the red line) had to be met by high price capacity (shown by the light orange shaded area), resulting in high prices for the services.

Around 9 pm, over an hour after the CPT had triggered, a rebid of capacity from high to low prices by Origin reduced the price to below the administered price cap as shown in Figure 1 and Figure 2.

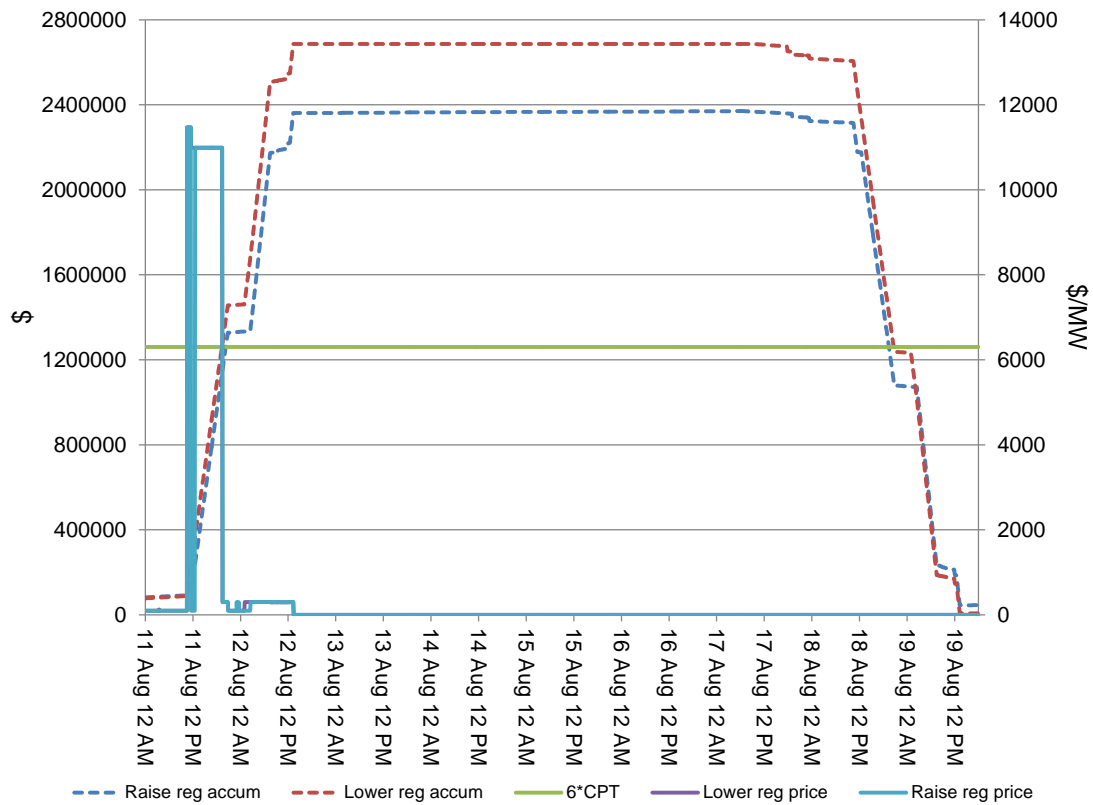
3.4 The cumulative price threshold

Under the National Electricity Rules⁷, if the sum of the previous 2016 dispatch prices exceeds six times the CPT (currently \$210 100) for any FCAS, then an administered price cap of \$300/MW is applied to all services where the price would exceed the administered price cap.

Figure 3 shows the cumulative prices of both regulation services (dashed red and blue lines for lower and raise respectively), the dispatch prices for both services (solid red and blue lines for lower and raise respectively) and six times the CPT value (solid green line at \$1 260 000, or six times \$210 000). The figure shows that the cumulative prices of both services (red and blue dashed lines) exceeded six times the CPT on 11 August before falling below the threshold again on 18 August.

⁷ Clause 3.14.2

Figure 3: South Australian local regulation services price, cumulative price and CPT



During an administered price period the cumulative price is calculated using uncapped prices based on generator offers. In other words the cumulative price is calculated according to what the price would have been, had the administered price cap not been applied. The dashed red and blue lines continue above the green line because prices based on generator offers remained high beyond 7.30 pm, the time the administered price cap (of \$300/MW) was imposed.

Australian Energy Regulator

November 2016

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. There are two general categories of FCAS:

- 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 the 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 will 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, that 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 and who pays

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

- Contingency FCAS: Generators pay for Raise Services and customers pay for Lower Services.
- Regulation FCAS: Cost recovery on a “causer pays” basis using the *Causer Pays Procedure* developed by AEMO in accordance with the appropriate Rules procedures.

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 single causer pays contribution factor that represents each market participants aggregate contribution to the need for regulation FCAS on a portfolio basis across the NEM. This contribution factor is not dependent on the amount of energy purchased/consumed by the participant – consequently a generator with a non-zero factor in a particular period will still pay a share of FCAS costs irrespective of how much of its generation is running. Any market generator, with a non-zero contribution factor with generating units in SA, will incur regulation FCAS costs.

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.

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 jurisdictional system security coordinator (JSSC). In the case of South Australia the JSSC determined the frequency band for separation of the South Australian power system to be 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 11 August – lower regulation

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from (\$/MW)	Price to (\$/MW)	Rebid reason
9.46 am	10.35 am	Origin	Quarantine	5	0	>11 900	0942A DEC IN SA DEM - 5PD 1681MW < 30PD 1728MW @ 1000 SL
11.06 pm	11.35 am	Origin	Quarantine	5	0	≥10 990	1055A DEC IN SA DEM - 5PD 1497MW < 30PD 1550MW @ 1130 SL
8.48 pm	8.55 pm	Origin	Quarantine	2	10 990	0	2045A ENERGY/FCAS TRADEOFF SL

Table C 2: Significant rebids for 11 August – raise regulation

Submit time	Time effective	Participant	Station	Capacity rebid (MW)	Price from (\$/MW)	Price to (\$/MW)	Rebid reason
9.46 am	10.35 am	Origin	Quarantine	5	0	12 350	0942A DEC IN SA DEM - 5PD 1681MW < 30PD 1728MW @ 1000 SL
11.55 am	12.35 pm	Origin	Quarantine	5	0	10 990	1151F ENERGY / FCAS PORTFOLIO OPTIMISATION SL
8.48 pm	8.55 pm	Origin	Quarantine	11	10 990	95	2045A ENERGY / FCAS TRADEOFF SL

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: Quarantine (Origin Energy) lower regulation service closing bid prices, dispatch and dispatch price - maximum offers]

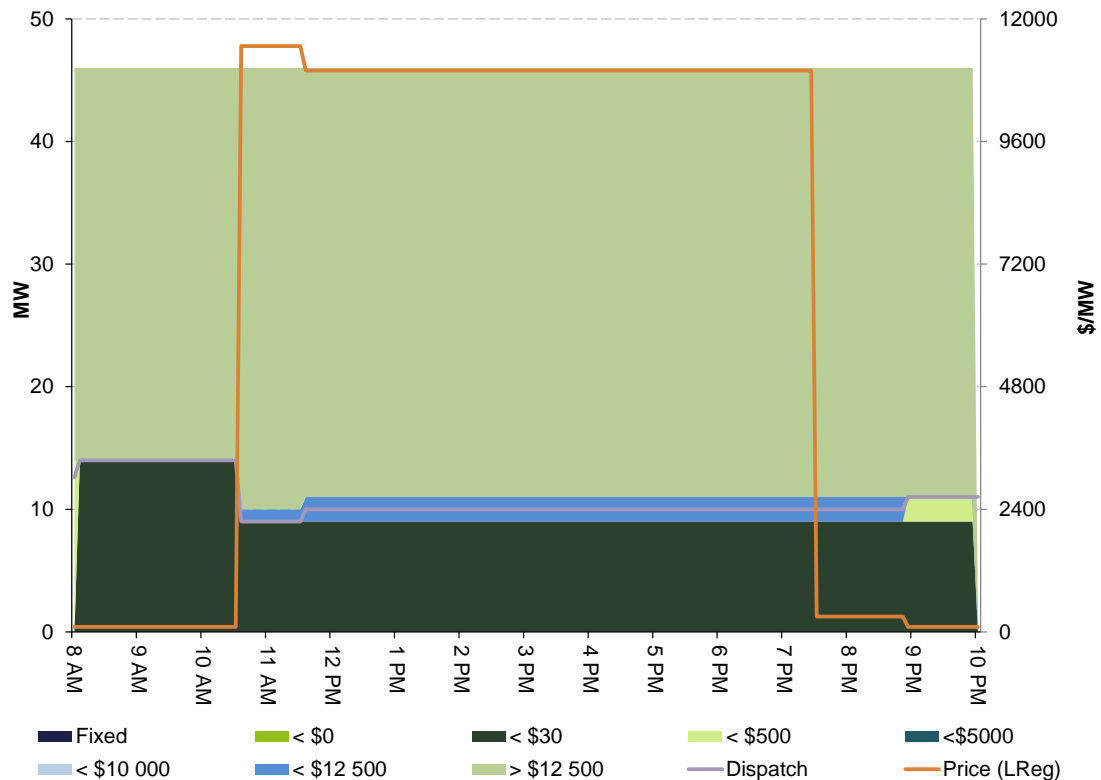


Figure D1b: Quarantine (Origin Energy) lower regulation service closing bid prices, dispatch and dispatch price - effective offers

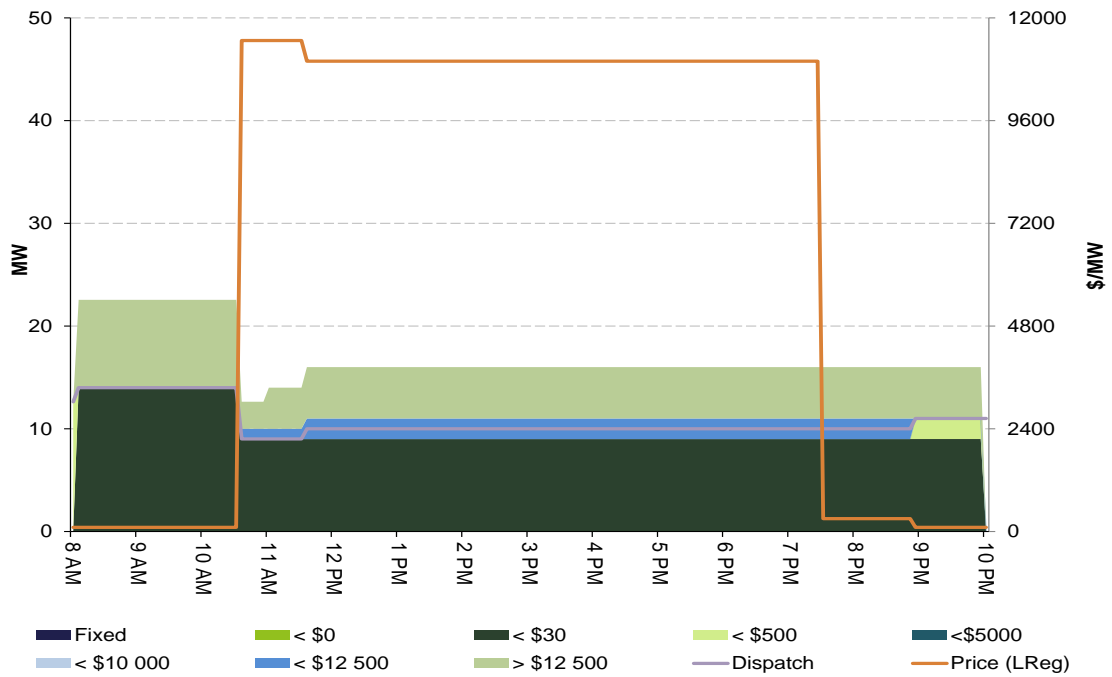


Figure D2a: Torrens Island (AGL) lower regulation service closing bid prices, dispatch and dispatch price – maximum offers

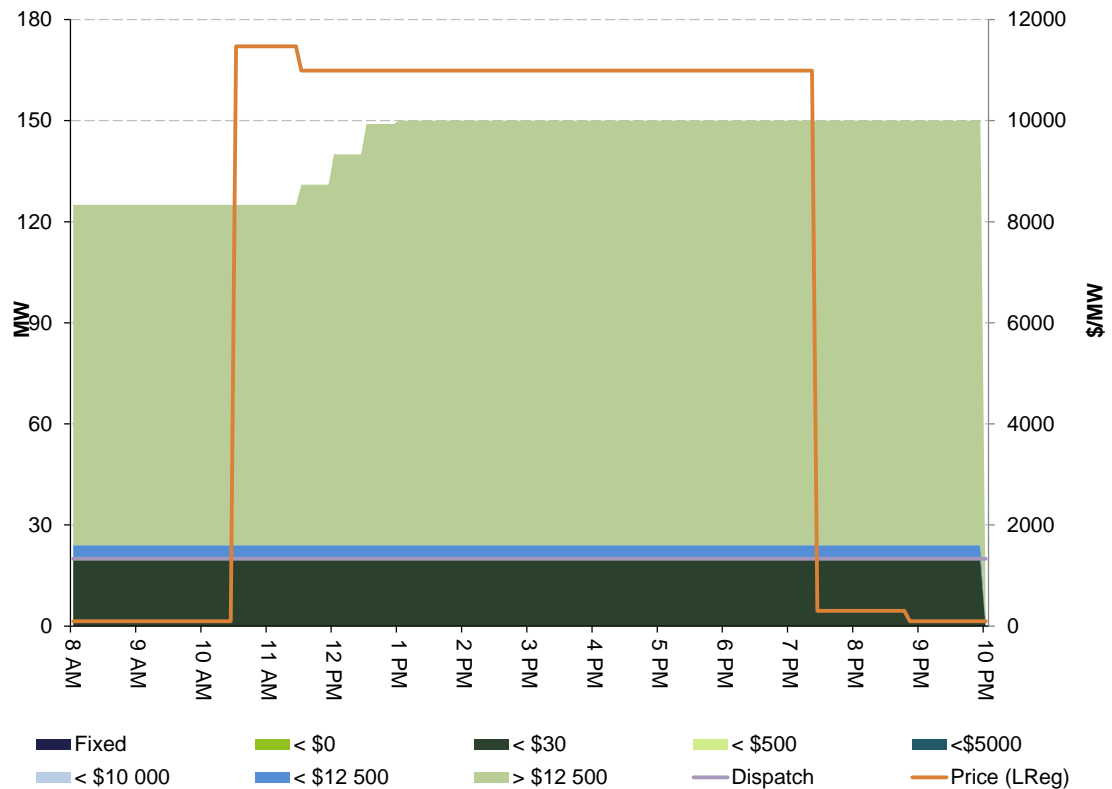


Figure D2b: Torrens Island (AGL) lower regulation service closing bid prices, dispatch and dispatch price – effective offers

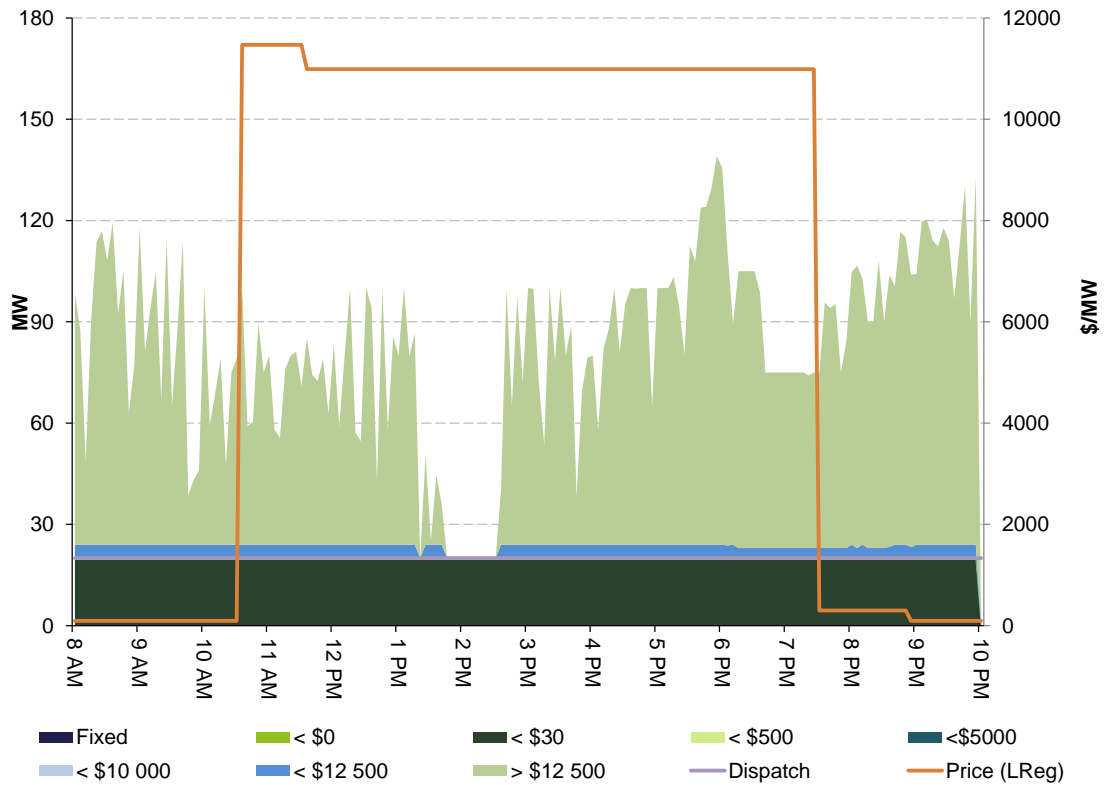


Figure D3a: Pelican Point (Engie) lower regulation service closing bid prices, dispatch and dispatch price – maximum offers

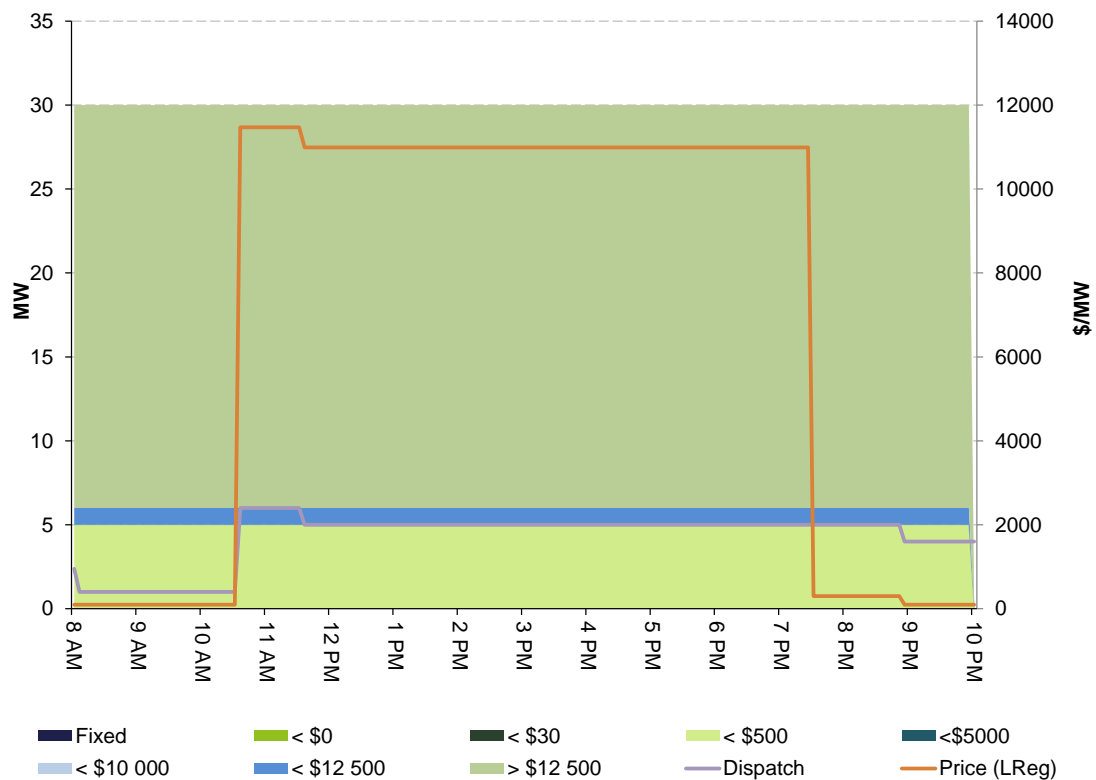
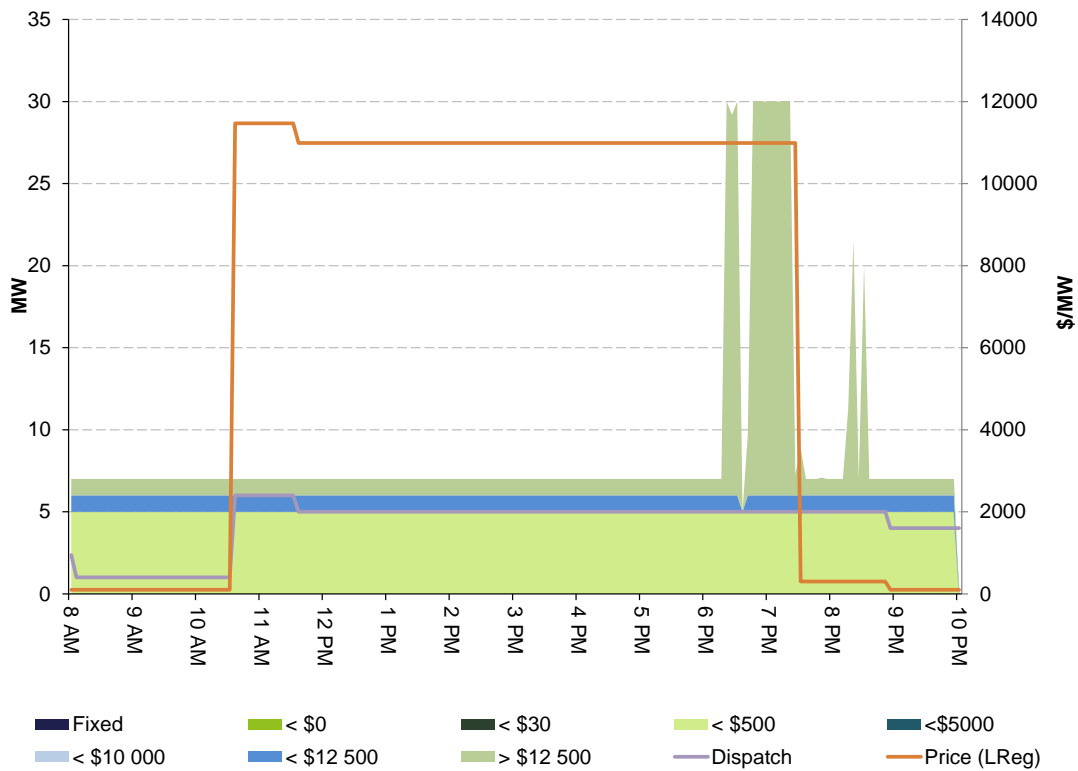


Figure D3b: Pelican Point (Engie) lower regulation service closing bid prices, dispatch and dispatch price – effective offers



Raise Regulation

Figure D4a: Quarantine (Origin) raise regulation service closing bid prices, dispatch and dispatch price for 11 August - maximum offers

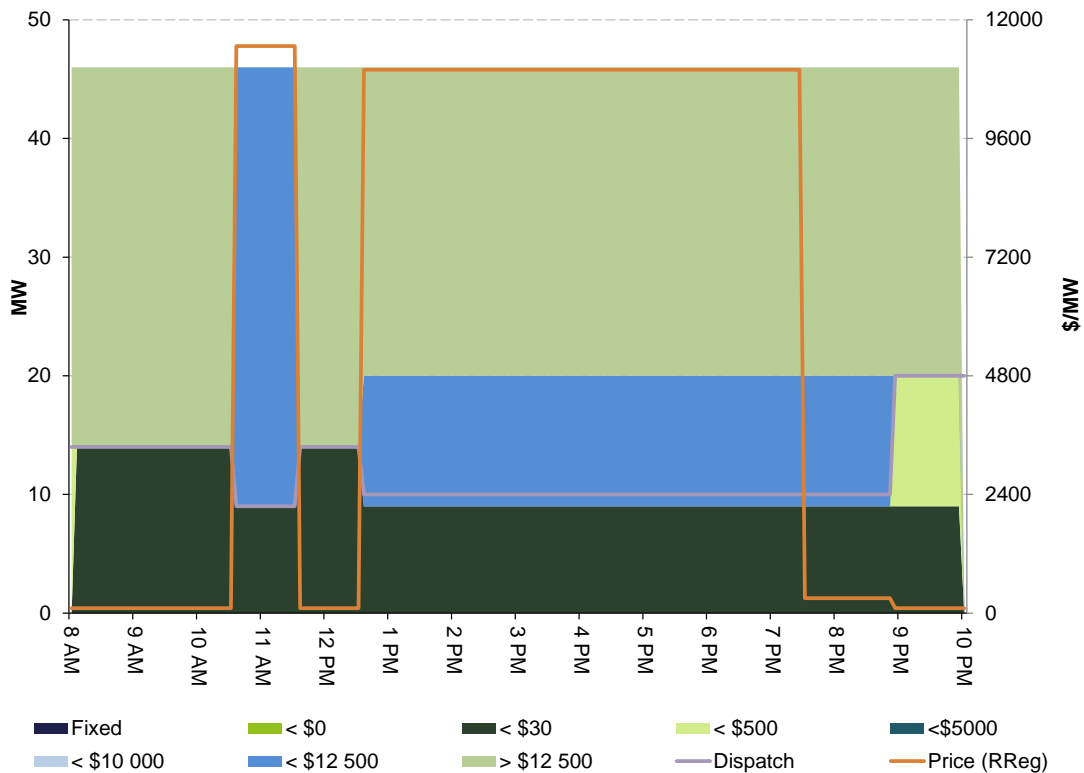


Figure D4b: Quarantine (Origin) raise regulation service closing bid prices, dispatch and dispatch price for 11 August - effective offers

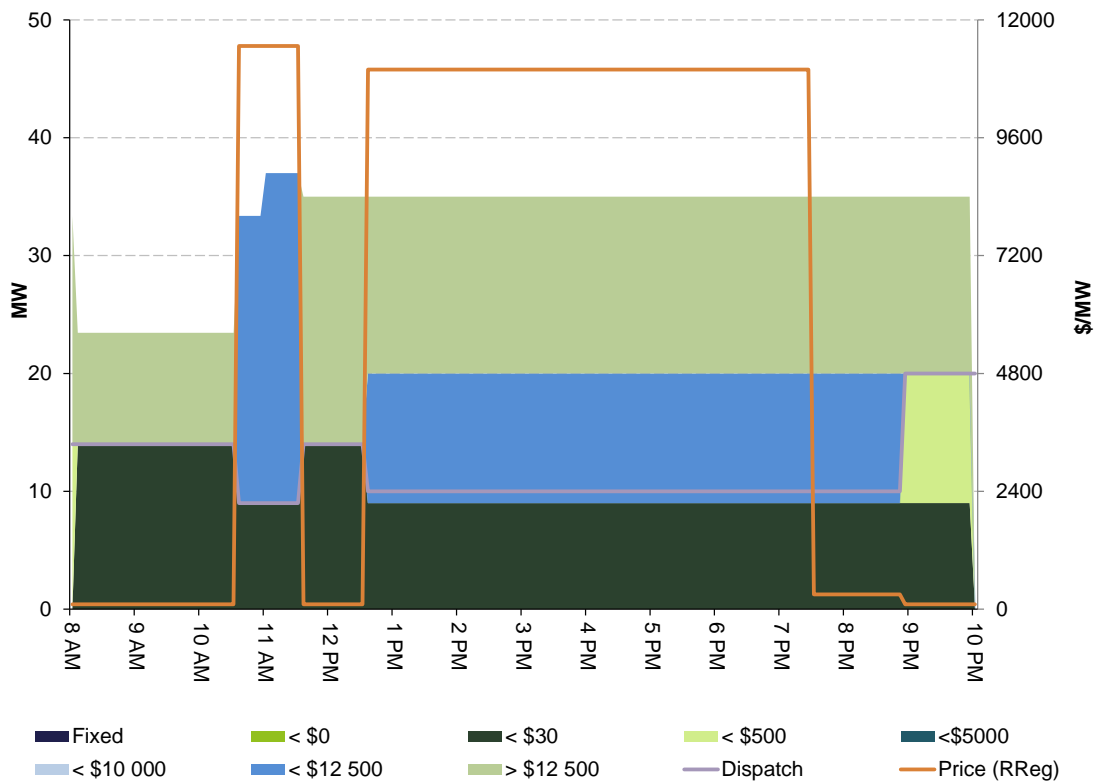


Figure D5a: Torrens Island (AGL) raise regulation service closing bid prices, dispatch and dispatch price for 11 August – maximum offers

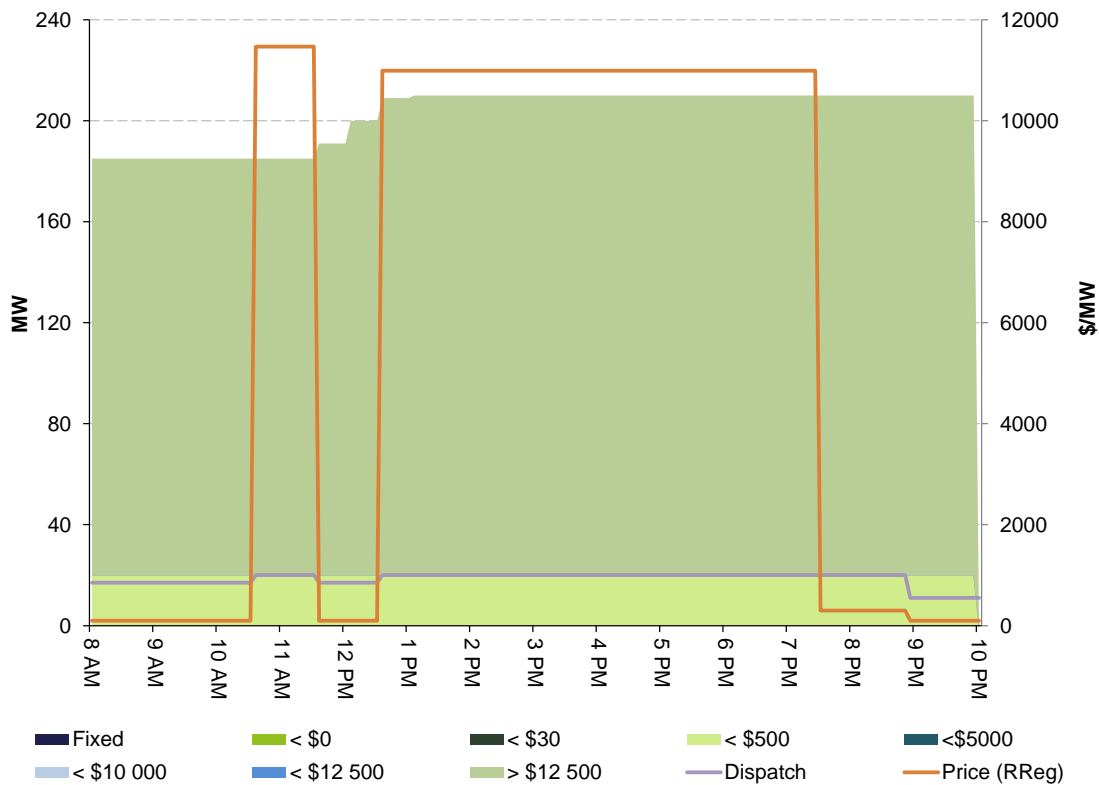


Figure D5b: Torrens Island (AGL) raise regulation service closing bid prices, dispatch and dispatch price for 11 August – effective offers

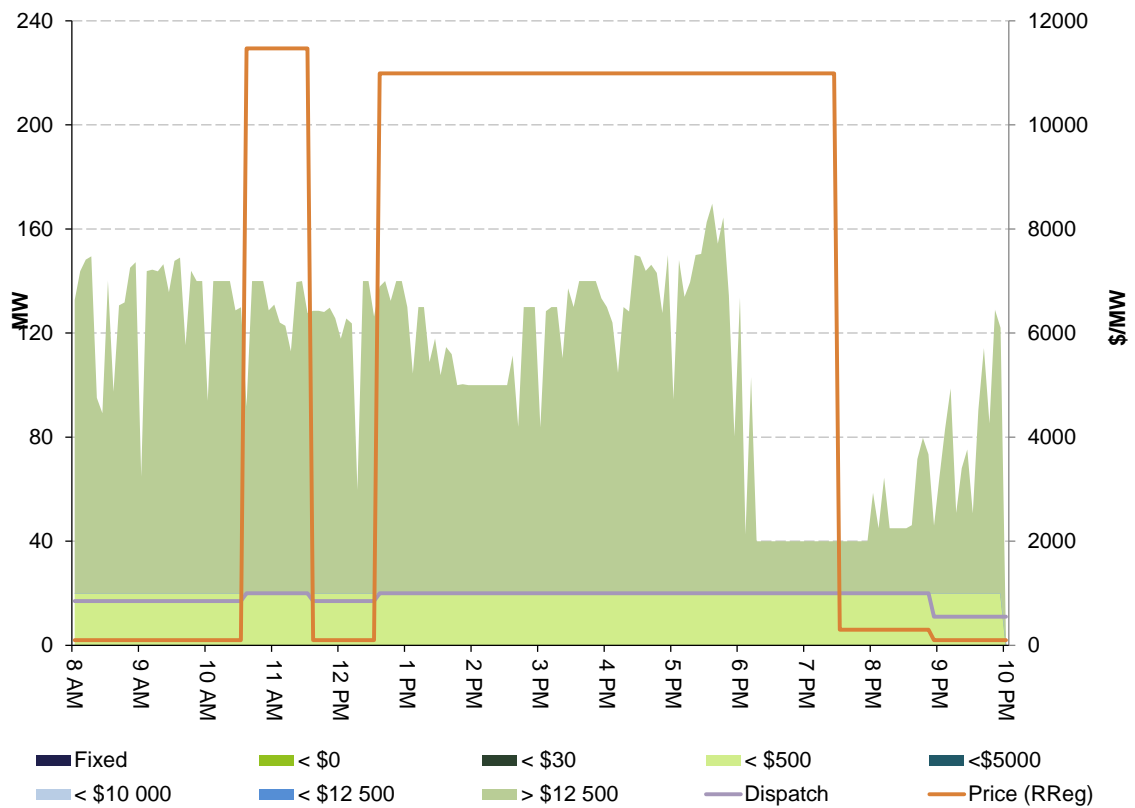


Figure D6a: Pelican Point (Engie) raise regulation service closing bid prices, dispatch and dispatch price for 11 August – maximum offers

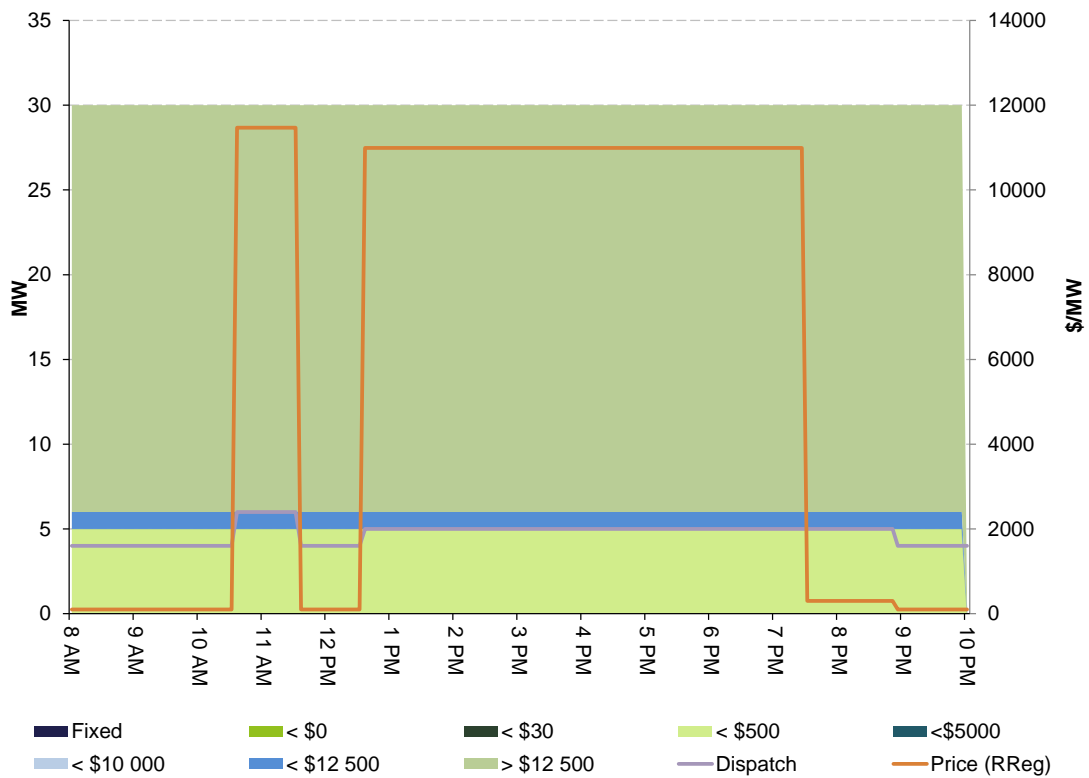
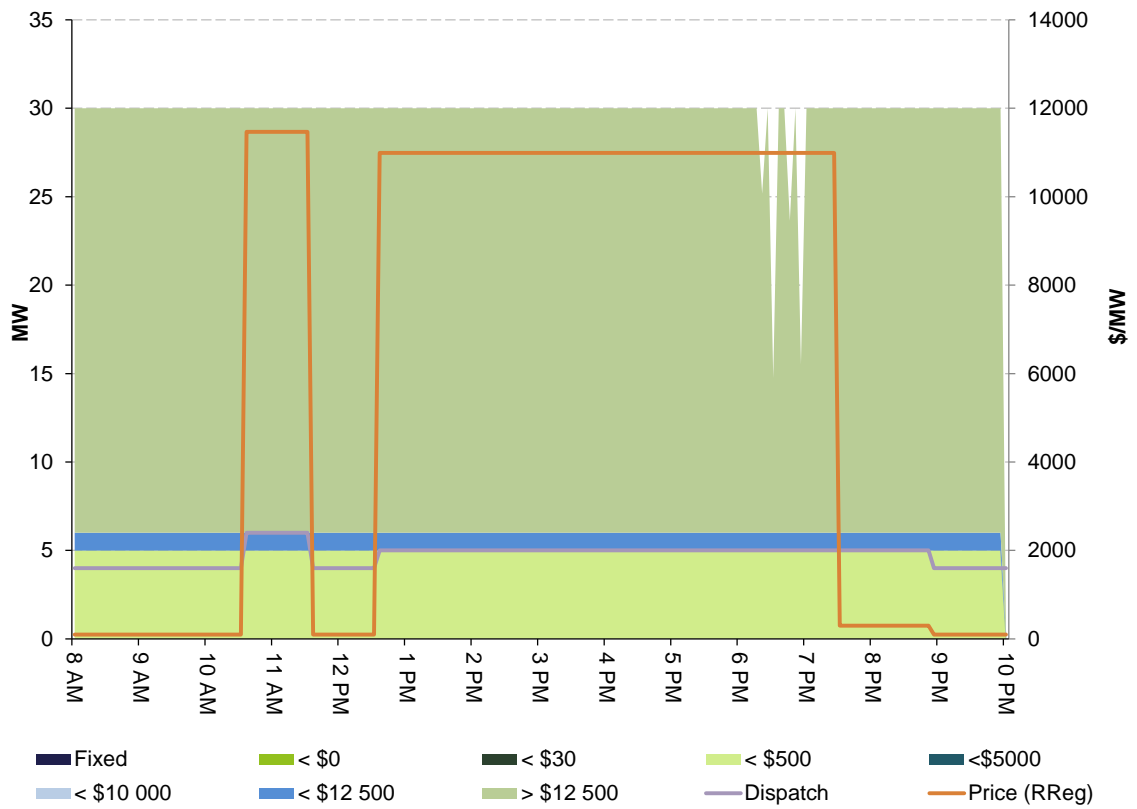


Figure D6b: Pelican Point (Engie) raise regulation service closing bid prices, dispatch and dispatch price for 11 August – effective offers



Appendix E Relevant Market Notices

AEMO issued the following market notice to advise of the outage.

Market notice 54624 was issued on 27 July 2016.

Market Notice	Type	Date of issue	Last Changed
54624	General Notice	27/07/2016 12:52:55	27/07/2016 12:52:55

Reason

AEMO ELECTRICITY MARKET NOTICE.

This market notice is FOR INFORMATION ONLY.

The Heywood No.1 500 kV busbar in Victoria Region is planned out of service from 0700 hrs on 10 August 2016 to 1700 hrs on 12 August 2016. During this outage, Heywood 500/275 kV M1 transformer will be off-loaded and Heywood - Tarrone - Alcoa Portland No.1 500 kV line will be open at Heywood.

During this outage, a credible contingency can separate South Australia region from the rest of the NEM.

Under these circumstances, 35 MW of Raise and Lower regulation FCAS will be sourced from South Australia for the duration of this outage. In addition, consistent with AEMO existing procedures, adequate contingency FCAS lower requirements will also be sourced from South Australia at times when power transfer is from South Australia to Victoria.

The following constraint sets have been invoked for this outage:

F-I_HYSE (includes F-S_LREG_0035 and F-S_RREG_0035)
S-BOTH_BLKRG_C_OS
V-HYTX_M12
V-HY_500BUS

Refer AEMO Network Outage Schedule (NOS) for further details.

AEMO will continue monitoring this proposed outage and will update the Market accordingly.

Operations Planning

Market notice 54699 was issued on 11 August 2016.

Market Notice	Type	Date of issue	Last Changed
54699	Administered price cap	11/08/2016 19:20:17	11/08/2016 19:20:17

Reason

AEMO ELECTRICITY MARKET NOTICE

Issued by Australian Energy Market Operator Ltd at 1920 hrs on 11 August 2016

ADMINISTERED PRICE PERIOD DECLARED in SA region.

AEMO has determined that the rolling sum of the uncapped market ancillary Lower Reg services(s) prices for the SA region over the previous 2016 dispatch intervals has exceeded 6 times the cumulative price threshold (CPT) of \$210,100.00.

In accordance with Clause 3.14 of the National Electricity Rules, AEMO has determined that an administered price period will commence at the dispatch interval starting 1925 hrs on 11 Aug 2016 and will continue through to the end of that trading day.

An administered price cap (APC) of 300 \$/MWh will apply to all dispatch intervals during this administered price period. This APC will apply to all market ancillary service prices in the SA region.

An administered floor price (AFP) of 0 \$/MWh AFP will apply to all market ancillary service prices.

AEMO will continue to monitor the rolling sum of the uncapped market ancillary service prices and issue further market notices as required.

This is an AEMO autogenerated Market Notice.

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.⁸ 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 11 August

DI	Dispatch Price (\$/MW)	Participant	Unit	Service	Offer price (\$/MW)	Marginal change	Contribution
10:35	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
10:40	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
10:45	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
10:50	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
10:55	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
11:00	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
11:05	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
11:10	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
11:15	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
11:20	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
11:25	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
11:30	\$11469.00	Engie	PPCCGT	Lower reg	\$11469.00	-1.00	-\$11469.00
11:35	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
11:40	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
11:45	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
11:50	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
11:55	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:00	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:05	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:10	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:15	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:20	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:25	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:30	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:35	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00

⁸ 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
12:40	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:45	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:50	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
12:55	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:00	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:05	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:10	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:15	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:20	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:25	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:30	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:35	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:40	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:45	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:50	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
13:55	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:00	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:05	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:10	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:15	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:20	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:25	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:30	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:35	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:40	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:45	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:50	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
14:55	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:00	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:05	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:10	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:15	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:20	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:25	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:30	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:35	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:40	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:45	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00

DI	Dispatch Price (\$/MW)	Participant	Unit	Service	Offer price (\$/MW)	Marginal change	Contribution
15:50	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
15:55	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:00	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:05	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:10	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:15	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:20	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:25	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:30	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:35	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:40	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:45	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:50	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
16:55	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:00	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:05	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:10	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:15	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:20	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:25	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:30	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:35	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:40	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:45	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:50	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
17:55	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:00	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:05	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:10	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:15	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:20	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:25	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:30	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:35	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:40	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:45	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:50	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
18:55	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00

DI	Dispatch Price (\$/MW)	Participant	Unit	Service	Offer price (\$/MW)	Marginal change	Contribution
19:00	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
19:05	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
19:10	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
19:15	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
19:20	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00
19:25	\$10990.00	Origin Energy	QPS5	Lower reg	\$10990.00	-1.00	-\$10990.00

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DI	Dispatch Price (\$/MW)	Participant	Unit	Service	Offer price (\$/MW)	Marginal change	Contribution
10:35	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
10:40	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
10:45	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
10:50	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
10:55	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
11:00	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
11:05	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
11:10	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
11:15	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
11:20	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
11:25	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
11:30	\$11469.00	Engie	PPCCGT	Raise reg	\$11469.00	-1.00	-\$11469.00
12:35	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
12:40	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
12:45	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
12:50	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
12:55	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:00	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:05	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:10	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:15	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:20	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:25	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:30	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:35	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:40	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:45	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:50	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
13:55	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00

DI	Dispatch Price (\$/MW)	Participant	Unit	Service	Offer price (\$/MW)	Marginal change	Contribution
14:00	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:05	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:10	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:15	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:20	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:25	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:30	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:35	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:40	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:45	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:50	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
14:55	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:00	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:05	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:10	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:15	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:20	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:25	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:30	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:35	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:40	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:45	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:50	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
15:55	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:00	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:05	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:10	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:15	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:20	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:25	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:30	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:35	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:40	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:45	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:50	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
16:55	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:00	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:05	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:10	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00

DI	Dispatch Price (\$/MW)	Participant	Unit	Service	Offer price (\$/MW)	Marginal change	Contribution
17:15	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:20	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:25	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:30	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:35	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:40	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:45	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:50	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
17:55	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:00	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:05	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:10	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:15	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:20	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:25	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:30	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:35	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:40	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:45	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:50	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
18:55	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
19:00	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
19:05	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
19:10	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
19:15	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
19:20	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00
19:25	\$10990.00	Origin Energy	QPS5	Raise reg	\$10990.00	-1.00	-\$10990.00