Report

Market ancillary service prices above $5000/MW
1 October 2013

December 2013

AUSTRALIAN ENERGY REGULATOR

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AER reference: 52729 – D13/156139

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Introduction

On 1 October 2013, the prices for local "lower 60 second" (L60) ancillary service and "lower 6 second" (L6) ancillary service prices in South Australia exceeded $5000/MW for nine consecutive dispatch intervals between 5.20 am and 6 am inclusive.

The AER is required to 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.[1]

The report must:

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

A detailed explanation of frequency control ancillary services (FCAS) is contained in appendix C.

Summary/assessment

Network arrangements in south eastern South Australia and south western Victoria are complex. The network that supports the Heywood interconnector in this area has changed significantly recently as result of new network configurations to accommodate Origin's Mortlake Power Station, AGL's Macarthur Wind Farm, and the Portland smelter, in south western Victoria. This is complicated further by the arrangements to manage post-contingency voltages whenever parts of the network in this vicinity are out of service for maintenance.

On 1 October 2013, the Heywood to Portland (APD) No.1 500 kV transmission line was out of service for planned maintenance. Early in the morning there was an unplanned outage of the M1 500/275 kV transformer at the Heywood terminal station. In response the Australian Energy Market Operator (AEMO) took the Heywood to Tarrone 500 kV line out of service. With the Heywood interconnector reduced to a single circuit, AEMO invoked constraints to manage local lower FCAS requirements and voltage stability.

The combination of generation from Mortlake and the outage of the Heywood to Tarrone line increased the requirement for local lower FCAS in South Australia (due to the increase in exports from South Australia to Victoria).

With a limited amount of lower-priced local lower services available, the increase in requirements for lower services could only be satisfied by high priced offers, which saw the price for "lower 60 second" ancillary services (L60) and "lower 6 second" ancillary services (L6) exceed $5000 MW for nine consecutive five-minute dispatch intervals. These high prices are the subject of this report. The price for "lower 5 minute" ancillary services (L5) and lower regulation services (LREG) also exceeded $5000/MW for four and five consecutive dispatch intervals respectively. The total cost for all of these services on the day, was around $1.6 million. This compares to less than $3000 per day for each of

[1] This requirement is set out in clause 3.13.7 (e) of the National Electricity Rules.

the services on a typical day. The cost of these local lower services is met by South Australian consumers.

This is the third such example of FCAS payments in South Australia related to transmission outages in Victoria since Mortlake Power Station was commissioned in October 2011.

AEMO has indicated in discussions with the AER that it is preparing a report into the conditions which led to an insecure operating state for a short period during these events.

Rebidding did not contribute to the high price outcomes and there were no significant impacts to energy spot market prices.

Events on the day

The Heywood to Portland (APD) No.1 500 kV transmission line was taken out of service on 23 September for planned maintenance, and was still out of service on 1 October. At 5.02 am on 1 October, there was an unplanned outage of the M1 500/275 kV transformer (as a result of a damaged 22 kV tertiary cable) at the Heywood terminal station, which is located just inside the Victoria side of the state border with South Australia. This area of the network is complex and presents many challenges for AEMO to manage.

This unplanned outage reduced the Heywood interconnector to a single circuit. In response, AEMO took the (unloaded) Heywood to Tarrone 500 kV line (which connects to the M1 transformer) out of service. This meant that the loss of the Heywood interconnector was then a credible contingency.

At the time of the unplanned outage (5.02 am), the Heywood interconnector was exporting at around 200 MW from South Australia to Victoria, and Origin Energy's (275 MW) Mortlake Power Station unit 1 was generating at around 200 MW.

When there is a potential separation event caused by the loss of an interconnector, local FCAS are usually required. If the region was previously exporting and the interconnector fails, then local lower services are required to lower the frequency. So in the event of a loss of the Heywood interconnector while exporting from South Australia, the resulting oversupply will lead to an increase in frequency in South Australia. In order to manage this, lower contingency FCAS must be sourced from suppliers in South Australia (typically generators). The requirement for this local lower FCAS is proportional to the flow across the interconnector from South Australia to Victoria. The concept of local FCAS is explained in more detail in Appendix C.

To meet local FCAS requirements in South Australia and address the voltage imbalance at APD caused by the unplanned outage, AEMO invoked a series of constraints which took effect from the 5.15 am and 5.20 am dispatch intervals respectively.[2]

The constraints invoked by AEMO at 5.15 am set the local lower FCAS requirements in South Australia, based on demand in South Australia and the balance of interconnector flows. These constraints immediately *reduced* the flows from South Australia into Victoria (by 154 MW from 198 MW to 34 MW) to minimise the impacts on lower service requirements and price.

The constraints then invoked at 5.20 am (which were *different* to those invoked at 5.15 am) were designed to limit voltage imbalances at Portland (APD) by reducing generation at Mortlake and *increasing* exports from South Australia into Victoria. As Mortlake unit 1 was generating at the time, this constraint bound immediately, increasing exports from South Australia to Victoria to 328 MW, and

[2] As per AEMO market notice no.43483 issued 1 October 2013.

consequently increasing requirements for local lower services in South Australia. The constraint reduced the output of Mortlake from 200 MW at 5.15 pm to zero at 5.45 pm.

Figure 1 shows requirements for local lower services in South Australia and corresponding prices. This figure shows that local requirements for L6 sec, L60 sec and LReg services increased significantly from 5.15 am to 5.20 am, when the second constraint (to limit the voltage imbalance) was invoked. It also shows that requirements for L5 min services increased from 5.20 am to 5.25 am. In all cases the significant increases in requirements led to corresponding increases in price.

Figure 1: South Australian local lower ancillary service requirements and price, 1 October

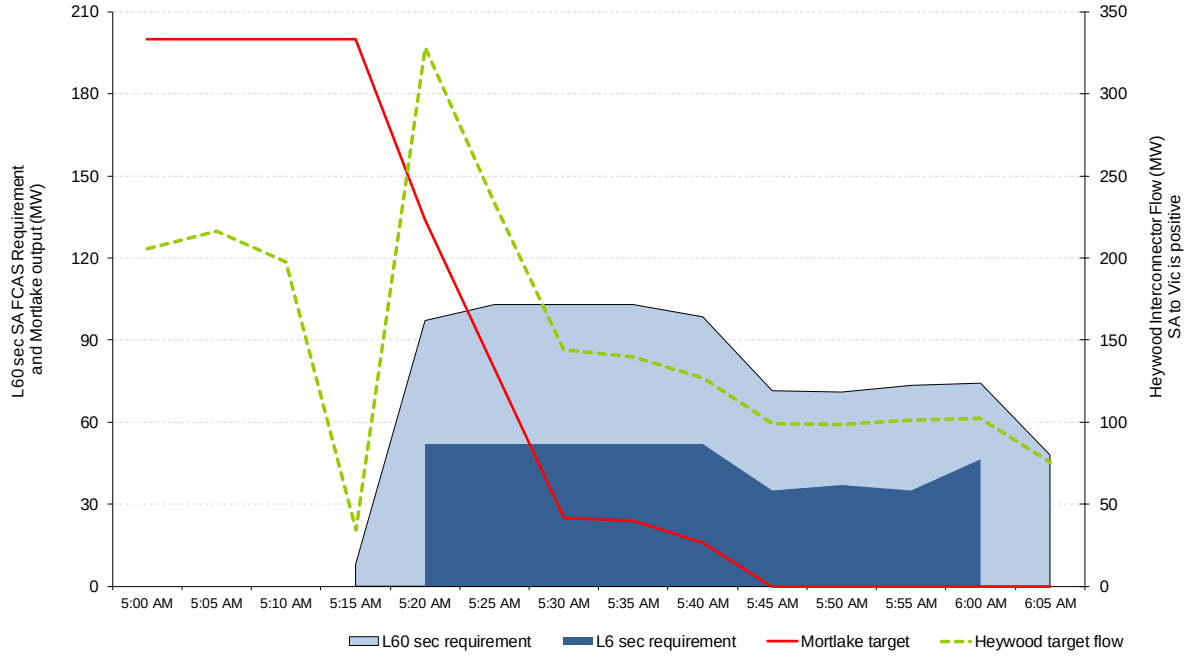
	L5 min		L60 sec		L6 sec		L REG	
Time (am)	**Req't (MW)**	**Price ($/MW)**	**Req't (MW)**	**Price ($/MW)**	**Req't (MW)**	**Price ($/MW)**	**Req't (MW)**	**Price ($/MW)**
5:10	0	0	0	0	0	0	0	0
5:15	0	0	8	91	0	0	0	0
5:20	0	0	97	13 100	52	13 100	44	13 100
5:25	78	9 161	103	13 100	52	13 100	30	9161
5:30	30	9 245	103	13 100	52	13 100	30	9246
5:35	21	9 134	103	13 100	52	13 100	35	9135
5:40	8	9 000	99	13 100	52	13 100	35	9001
5:45	0	0	71	13 100	35	13 100	15	137
5:50	0	0	71	13 100	37	13 100	15	135
5:55	0	0	73	13 100	35	13 100	17	92
6:00	0	0	74	13 100	46	13 100	18	12
6:05	0	0	48	46	0	0	0	0

Figure 2 shows the requirement and price for local L60 and L6 services, the scheduled output of the Mortlake generator and flow across the Heywood interconnector for each five minute dispatch interval during the high priced period. It highlights the relationship between Mortlake target generation and forced exports from South Australia (shown on the right hand side vertical axis) and the local L6 and L60 second service requirement. Two sets of constraints were invoked at 5.15 am and 5.20 am which have different purposes. The FCAS constraints have been part of market systems for many years and are designed to drive local FCAS requirements for South Australia when the region is exporting power to Victoria across a single Heywood interconnector circuit. The voltage imbalance constraints co-optimise Heywood interconnector flow into Victoria against generation at Mortlake and demand in South Australia. When Mortlake is generating, this pushes flow into Victoria. A positive flow indicates export of electricity from South Australia to Victoria.

Figure 2 shows, that when the FCAS constraint was first invoked at 5.15 am, flow across the Heywood interconnector reduced to 34 MW into Victoria (as shown by the reduction in the dotted green line). When the voltage imbalance constraints were first invoked at 5.20 am Mortlake unit one was targeted at 134 MW. The unit then received targets, in accordance with their ramp down rate, to reduce their output. As the constraint is designed to optimise the interconnector flow against Mortlake's output (shown by the red line), the fact that Mortlake is generating means that flows into Victoria increase (as shown by the upturn in the green dotted line). This is matched by an increase in the requirement for local lower services in South Australia, as shown by the increase in the blue shaded area.

The figure then shows that as generation from Mortlake reduces, so does the requirements for imports into Victoria (the red line mirrors the fall in the green dotted line). That is, the FCAS constraints and voltage imbalance constraints work together when Mortlake is not generating (but essentially they work "against" each other when it is generating).

Figure 2: SA local L6 and L60 second requirements, Heywood interconnector flow, and Mortlake generation, 1 October



Generator FCAS offers

There are only three power stations registered to provide L6 and L60 services in South Australia: Northern Power Station (owned by Alinta Energy); Torrens Island A and B (owned by AGL); and Pelican Point Power Station (owned by GDF Suez). The Torrens Island B units are the only registered providers of L5. Torrens Island B, Northern Power Station and Pelican Point are the only participants registered to provide LREG.

Rebidding was not a factor in the high price outcomes. However, as discussed below, the increase in requirement for lower services in South Australia could not be met by lower-price offers, and instead was met by high-price offers. The amount of capacity of each of the lower services available at the time of high prices (based on effective bids)[3], was as follows:

- L60 sec: 53 MW of available capacity priced at less than $5000/MW. As shown in figure 1, the requirement reached a maximum of 103 MW during the time of high prices.
- L6 sec: 18 MW of available capacity priced at less than $5000/MW. As shown in figure 1, the requirement reached a maximum of 52 MW during the time of high prices.
- Lower Reg: 30 MW of available capacity was priced at less than $5000/MW. As shown in figure 1, the requirement reached a maximum of 44 MW during the time of high prices.
- All L5 min services capacity was priced at $9000/MW.

It is clear from the above that there was insufficient *effective* low-price capacity to meet the increased requirements.

AGL is the largest provider of FCAS in South Australia. The requirement for local lower FCAS saw the high priced FCAS offers from AGL dispatched and setting the price for all high-price dispatch intervals. The generators involved in setting the price during the high-price period and how that price

[3] Effective bids take into account the interaction of energy and the offered FCAS trapezium. In other words, on occasion there may be less capacity "effectively" (or actually) available than that offered.

was determined by the market systems is detailed in Appendix A. The closing bids of the generators offering lower FCAS services are presented in Appendix B.

Conclusion

The management of voltage in south-western Victoria is leading to costly FCAS requirements in South Australia from time to time. The issues concerning the network in the area are complicated. The AER will be exploring these issues with AEMO further to see if there are ways to lessen the market impacts.

Appendix A – FCAS price setters for 1 October 2013

The following tables identify for the five-minute FCAS dispatch prices above $5000/MW, each price and the generating units involved in setting the price for each of the lower Frequency Control Ancillary Services in South Australia. This information is published by AEMO. Also shown is 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.

South Australia – lower 60 second FCAS – 1 October 2013

Time	Dispatch Price	Participant	Unit	Service	Offer Price	Marginal change	Contribution
5:20 AM	13208.93[6]	AGL (SA)	TORRB4	L60S	13100	-1	-13100
		AGL (SA)	TORRB4	ENOF	199.99	-0.71	-141.9929
		Hydro Tasmania	POAT220	ENOF	38.28	0.86	32.9208
		AGL	LYA4	R60S	0.8	0.79	0.632
		Hydro Tasmania	GORDON	R60S	0.79	-0.79	-0.6241
		Hydro Tasmania	GORDON	L60S	0.5	0.79	0.395
		Hydro Tasmania	JBUTTERS	L5MI	0.2	-0.86	-0.172
		Hydro Tasmania	POAT220	L5MI	0.2	0.86	0.172
			T-V-MNSP1,VIC1	ENOF	0.01	0.79	0.0079
5:25 AM	13100	AGL (SA)	TORRB2	L60S	13100	-1	-13100
5:30 AM	13100	AGL (SA)	TORRB2	L60S	13100	-1	-13100
5:35 AM	13100	AGL (SA)	TORRB4	L60S	13100	-1	-13100
5:40 AM	13195.17[6]	AGL (SA)	TORRB4	L60S	13100	-1	-13100
		AGL (SA)	TORRB2	L5MI	9000	0.71	6390
		AGL (SA)	TORRB4	L5MI	9000	-0.71	-6390
		AGL (SA)	TORRB4	ENOF	90.8	-0.71	-64.468
		Infratil	SNOWTWN1	ENOF	-43.14	0.71	-30.6294
5:45 AM	13178.76[6]	AGL (SA)	TORRB2	L60S	13100	-1	-13100
		AGL (SA)	TORRB2	ENOF	90.8	-0.58	-52.664
		EnergyAustralia	WATERLWF	ENOF	-45	0.58	-26.1
5:50 AM	13100	AGL (SA)	TORRB4	L60S	13100	-1	-13100
5:55 AM	13152.66[4]	AGL (SA)	TORRB2	L60S	13100	-1	-13100
		AGL (SA)	TORRB2	ENOF	90.8	-0.58	-52.664
		Infigen	LKBONNY3	ENOF	0	0.19	0
		GDF Suez	PPCCGT	ENOF	0	0.39	0
6:00 AM	13100	AGL (SA)	TORRB2	L60S	13100	-1	-13100

[4] capped at $13 000/MWh

South Australia – lower 6 second FCAS – 1 October 2013

Time	Dispatch Price	Participant	Unit	Service	Offer Price	Marginal change	Contribution
5:20 AM	13100	AGL (SA)	TORRB4	L6SE	13100	-1	-13100
5:25 AM	13100	AGL (SA)	TORRB2	L6SE	13100	-1	-13100
5:30 AM	13100	AGL (SA)	TORRB2	L6SE	13100	-1	-13100
5:35 AM	13100	AGL (SA)	TORRB2	L6SE	13100	-1	-13100
5:40 AM	13100	AGL (SA)	TORRB4	L6SE	13100	-1	-13100
5:45 AM	13100	AGL (SA)	TORRB4	L6SE	13100	-1	-13100
5:50 AM	13260.73[6]	AGL (SA)	TORRB2	L60S	13100	-2.07	-27117
		AGL (SA)	TORRB2	L6SE	13100	-1	-13100
		AGL (SA)	TORRB4	L60S	13100	2.07	27117
		AGL (SA)	TORRB2	ENOF	90.8	-0.6	-54.48
		AGL (SA)	TORRB4	ENOF	90.8	-0.6	-54.48
		AGL (SA)	TORRB2	L5RE	1.5	0.6	0.9
		AGL (SA)	TORRB4	L5RE	1.5	-0.6	-0.9
		Infratil	SNOWTWN1	ENOF	-43.14	1.2	-51.768
5:55 AM	13100	AGL (SA)	TORRB2	L6SE	13100	-1	-13100
6:00 AM	13100	AGL (SA)	TORRB4	L6SE	13100	-1	-13100

South Australia – lower 5 minute FCAS – 1 October 2013

Time	Dispatch Price	Participant	Unit	Service	Offer Price	Marginal change	Contribution
5:20 AM	13252.71[5]	AGL (SA)	TORRB4	L5RE	13100	-1	-13100
		AGL (SA)	TORRB4	ENOF	199.99	-1	-199.99
		Hydro Tasmania	POAT220	ENOF	38.28	1.2	45.936
		AGL	LYA4	L5RE	0.8	1	0.8
		AGL	LYA4	R60S	0.8	1.11	0.888
		Hydro Tasmania	GORDON	R60S	0.79	-1.11	-0.8769
		Hydro Tasmania	GORDON	L60S	0.5	1.11	0.555
		Hydro Tasmania	JBUTTERS	L5MI	0.2	-2.2	-0.44
		Hydro Tasmania	POAT220	L5MI	0.2	1.2	0.24
			T-V-MNSP1,VIC1	ENOF	0.01	1.11	0.0111
5:25 AM	9160.5	AGL (SA)	TORRB4	L5MI	9000	-1	-9000
		AGL (SA)	TORRB4	ENOF	199.99	-1	-199.99
		GDF Suez	LOYYB1	ENOF	43.7	0.45	19.665
		GDF Suez	LOYYB2	ENOF	43.7	0.45	19.665
5:30 AM	9244.99	AGL (SA)	TORRB2	L5MI	9000	-0.5	-4500
		AGL (SA)	TORRB4	L5MI	9000	-0.5	-4500
		AGL (SA)	TORRB2	ENOF	199.99	-0.5	-99.995
		AGL (SA)	TORRB4	ENOF	199.99	-0.5	-99.995
		EnergyAustralia	WATERLWF	ENOF	-45	1	-45
5:35 AM	9133.94	AGL (SA)	TORRB2	L5MI	9000	-0.5	-4500
		AGL (SA)	TORRB4	L5MI	9000	-0.5	-4500
		AGL (SA)	TORRB2	ENOF	90.8	-0.5	-45.4
		AGL (SA)	TORRB4	ENOF	90.8	-0.5	-45.4
		Infratil	SNOWTWN1	ENOF	-43.14	1	-43.14
5:40 AM	9000	AGL (SA)	TORRB2	L5MI	9000	-1	-9000

[5] capped at $13 000/MWh

South Australia – lower regulation FCAS – 1 October 2013

Time	Dispatch Price	Participant	Unit	Service	Offer Price	Marginal change	Contribution
5:20 AM	13253.31[6]	AGL (SA)	TORRB4	L5RE	13100	-1	-13100
		AGL (SA)	TORRB4	ENOF	199.99	-1	-199.99
		Hydro Tasmania	POAT220	ENOF	38.28	1.2	45.936
		AGL	LYA4	R60S	0.8	1.11	0.888
		Hydro Tasmania	GORDON	R60S	0.79	-1.11	-0.8769
		Hydro Tasmania	GORDON	L60S	0.5	1.11	0.555
		Hydro Tasmania	JBUTTERS	L5MI	0.2	-1.2	-0.24
		Hydro Tasmania	POAT220	L5MI	0.2	1.2	0.24
			T-V-MNSP1,VIC1	ENOF	0.01	1.11	0.0111
5:25 AM	9161.1	AGL (SA)	TORRB4	L5MI	9000	-1	-9000
		AGL (SA)	TORRB4	ENOF	199.99	-1	-199.99
		GDF Suez	LOYYB1	ENOF	43.7	0.45	19.665
		GDF Suez	LOYYB2	ENOF	43.7	0.45	19.665
		Macquarie Generation	BW01	L5RE	0.8	-1	-0.8
		Hydro Tasmania	TRIBUTE	L5MI	0.2	1	0.2
5:30 AM	9245.78	AGL (SA)	TORRB2	L5MI	9000	-0.5	-4500
		AGL (SA)	TORRB4	L5MI	9000	-0.5	-4500
		AGL (SA)	TORRB2	ENOF	199.99	-0.5	-99.995
		AGL (SA)	TORRB4	ENOF	199.99	-0.5	-99.995
		CS Energy	GSTONE4	L5RE	0.99	-1	-0.99
		Hydro Tasmania	JBUTTERS	L5MI	0.2	1	0.2
		EnergyAustralia	WATERLWF	ENOF	-45	1	-45
5:35 AM	9134.54	AGL (SA)	TORRB2	L5MI	9000	-0.5	-4500
		AGL (SA)	TORRB4	L5MI	9000	-0.5	-4500
		AGL (SA)	TORRB2	ENOF	90.8	-0.5	-45.4
		AGL (SA)	TORRB4	ENOF	90.8	-0.5	-45.4
		AGL	LYA1	L5RE	0.8	-1	-0.8
		Hydro Tasmania	JBUTTERS	L5MI	0.2	1	0.2
		Infratil	SNOWTWN1	ENOF	-43.14	1	-43.14
5:40 AM	9000.6	AGL (SA)	TORRB2	L5MI	9000	-1	-9000
		AGL	LYA1	L5RE	0.8	-1	-0.8
		Hydro Tasmania	GORDON	L5MI	0.2	1	0.2

Appendix B – FCAS offers for 1 October 2013

Figures B1a to B9a highlight for each dispatch interval the lower services FCAS closing bids for AGL, Alinta Energy and GDF Suez (the only participants in South Australia with capacity priced at or above $5000/MW during the period the price exceeded $5000/MW). It also shows the dispatch level of the respective services at each station and the dispatch price. Figures B1b to B9b show the effective bids taking into account the interaction of energy and the offered FCAS trapezium.

Figure B1a: Torrens Island B (AGL) lower 60 second service closing bid prices, dispatch and dispatch price for 1 October

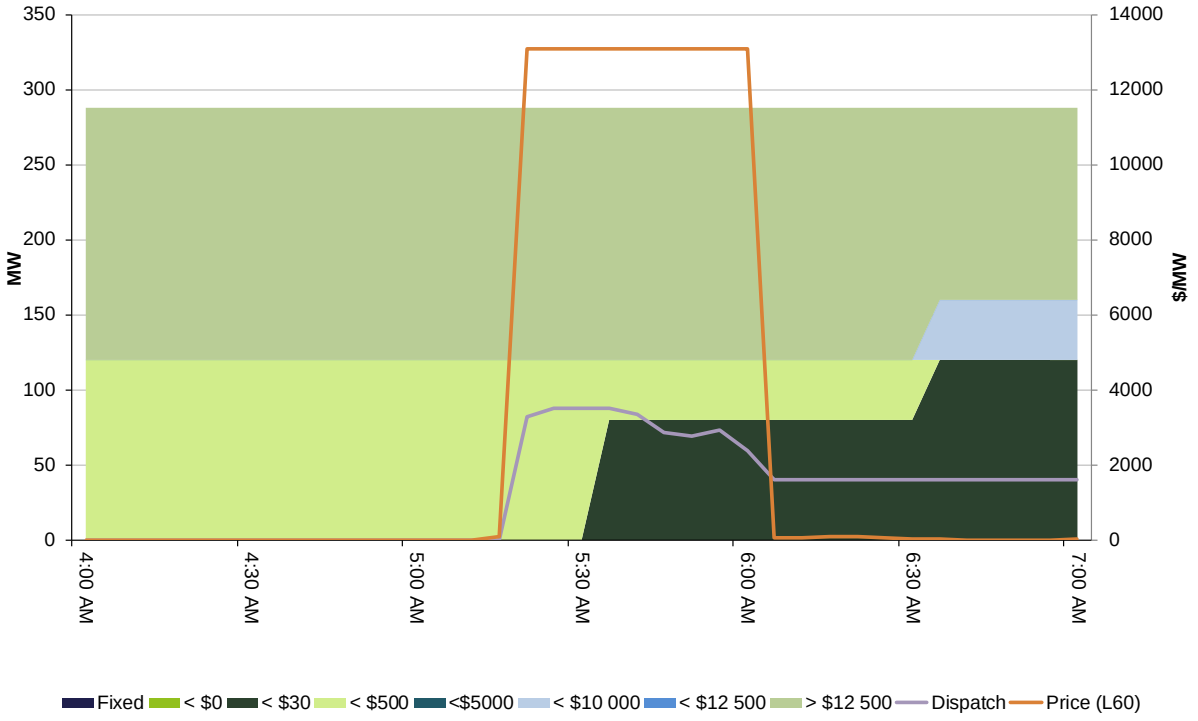


Figure B1b: Torrens Island B (AGL) lower 60 second service closing bid prices, dispatch and dispatch price for 1 October – effective offers

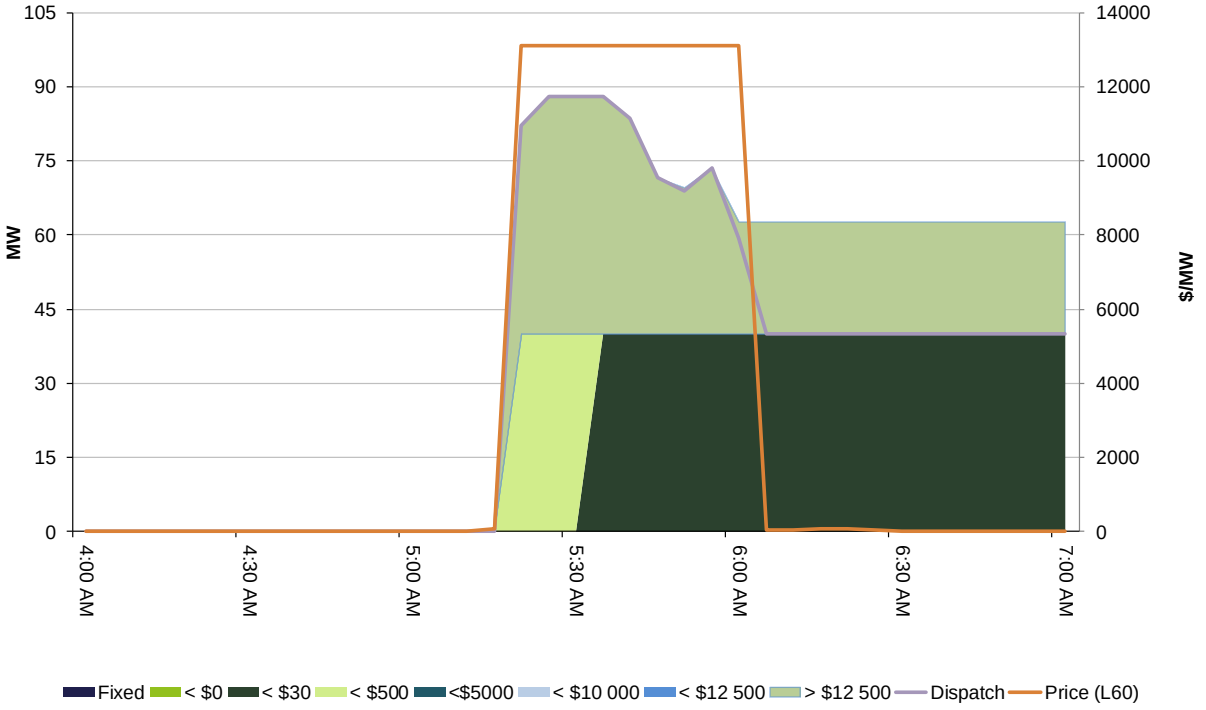


Figure B2a: Torrens Island B (AGL) lower 6 second service closing bid prices, dispatch and dispatch price for 1 October

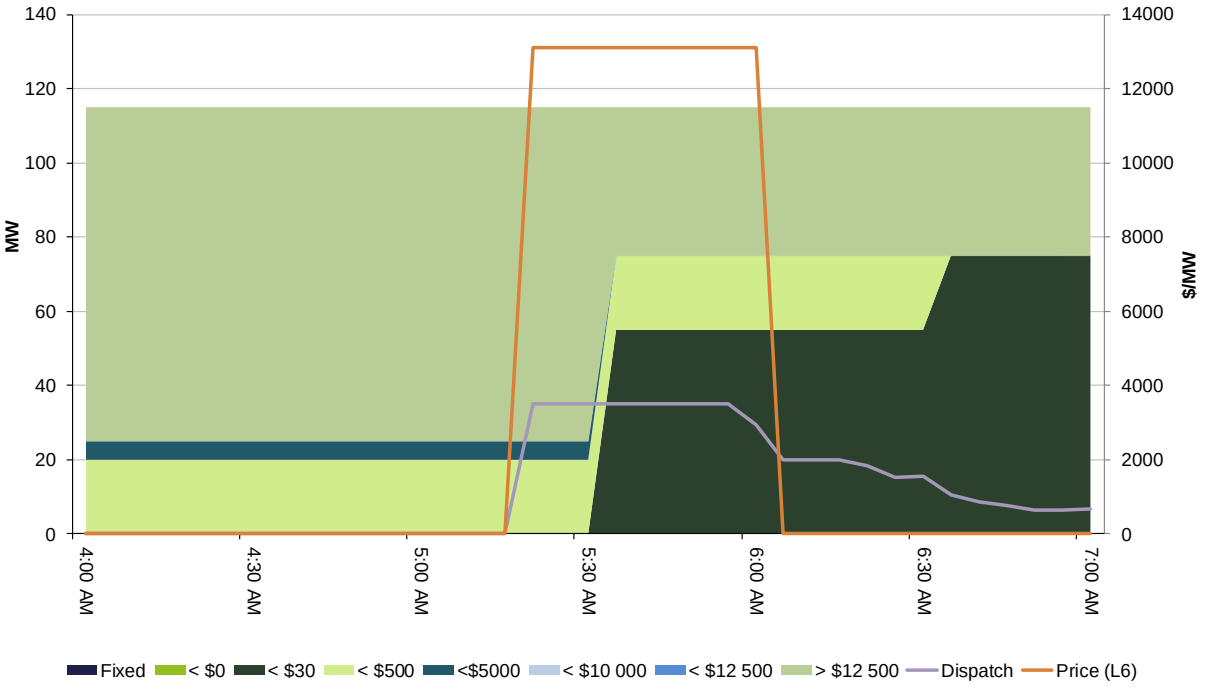


Figure B2b: Torrens Island B (AGL) lower 6 second service closing bid prices, dispatch and dispatch price for 1 October – effective offers

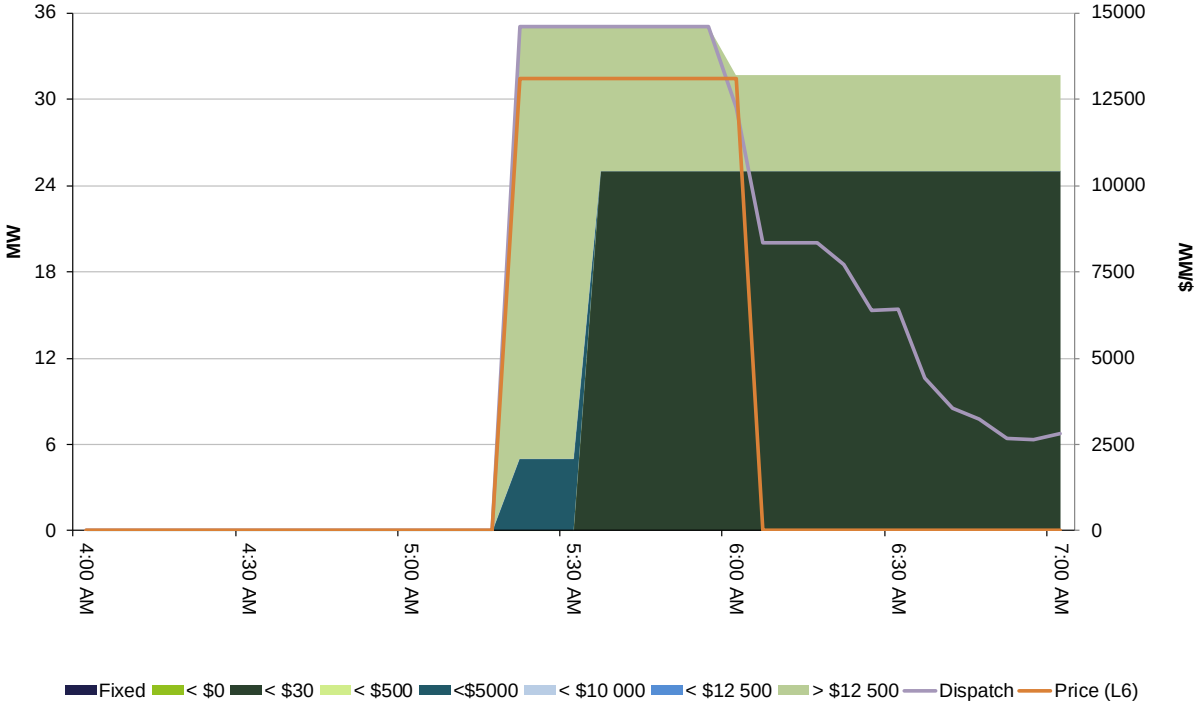


Figure B3a: Torrens Island B (AGL) lower 5 minute service closing bid prices, dispatch and dispatch price for 1 October

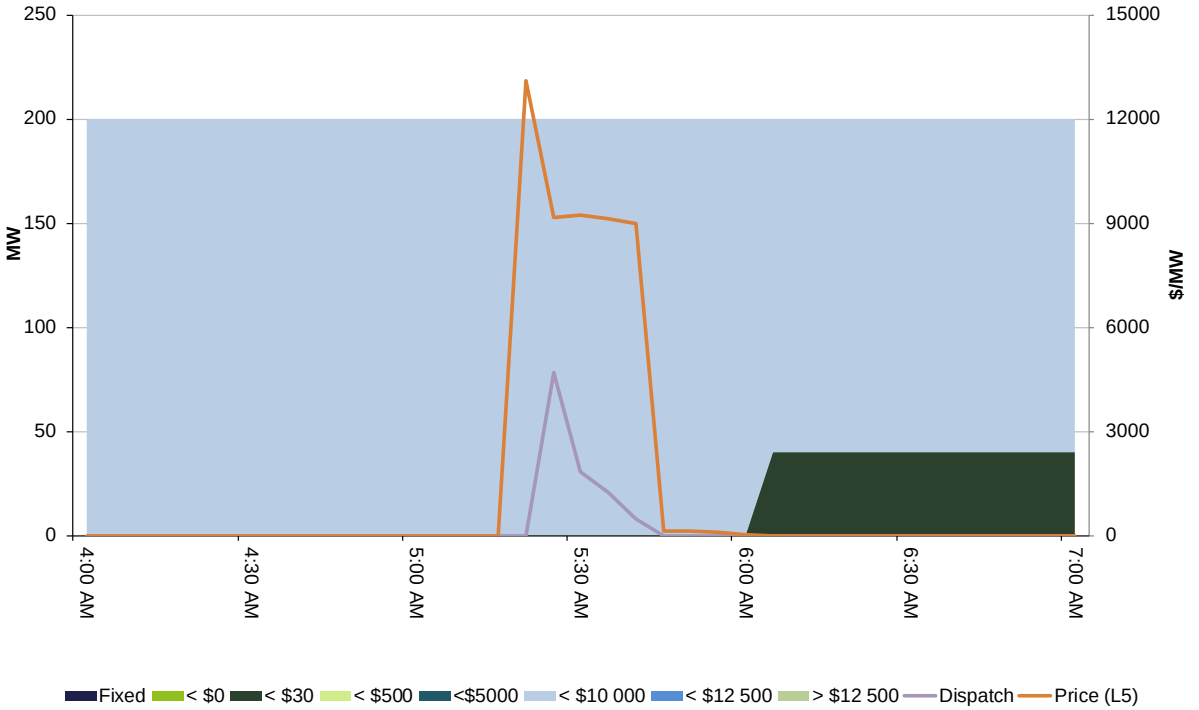


Figure B3b: Torrens Island B (AGL) lower 5 minute service closing bid prices, dispatch and dispatch price for 1 October – effective offers

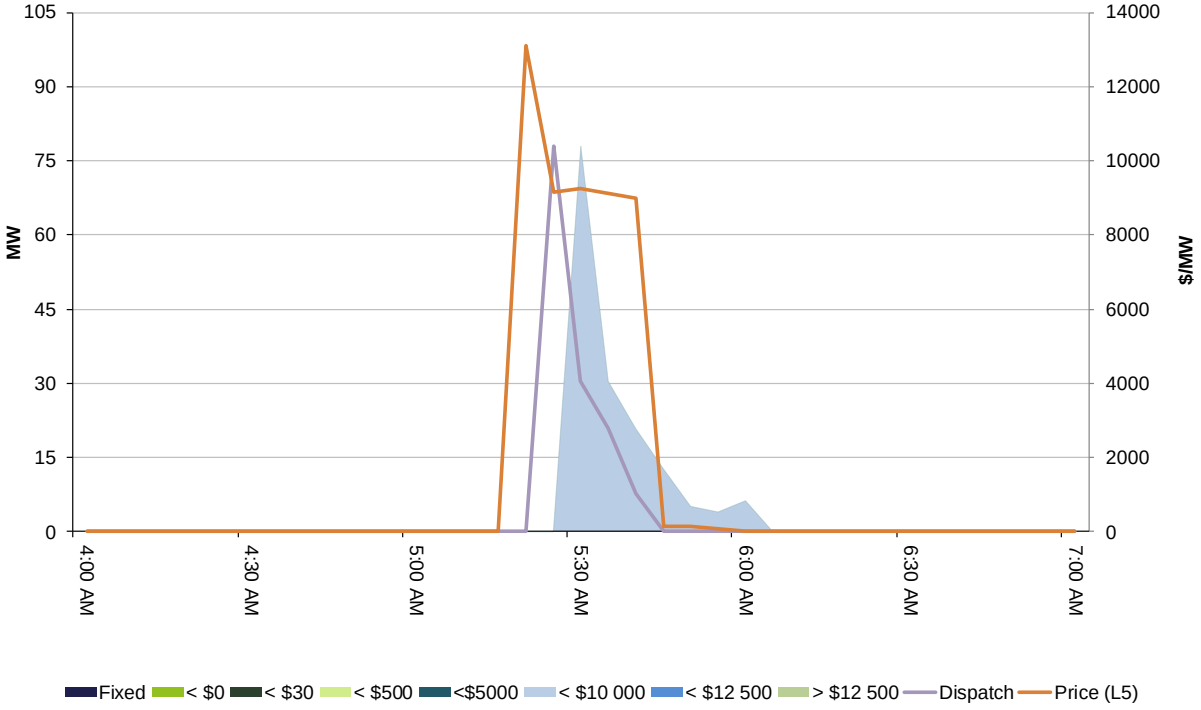


Figure B4a: Torrens Island B (AGL) lower regulation service closing bid prices, dispatch and dispatch price for 1 October

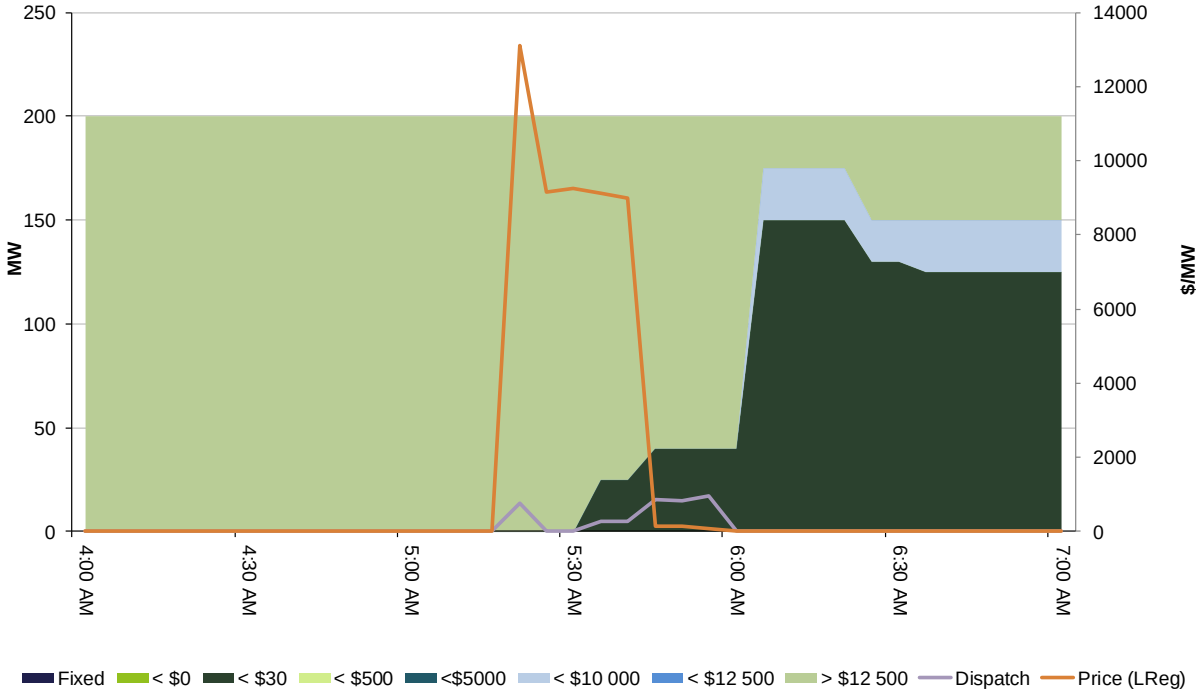


Figure B4b: Torrens Island B (AGL) lower regulation service closing bid prices, dispatch and dispatch price for 1 October – effective offers

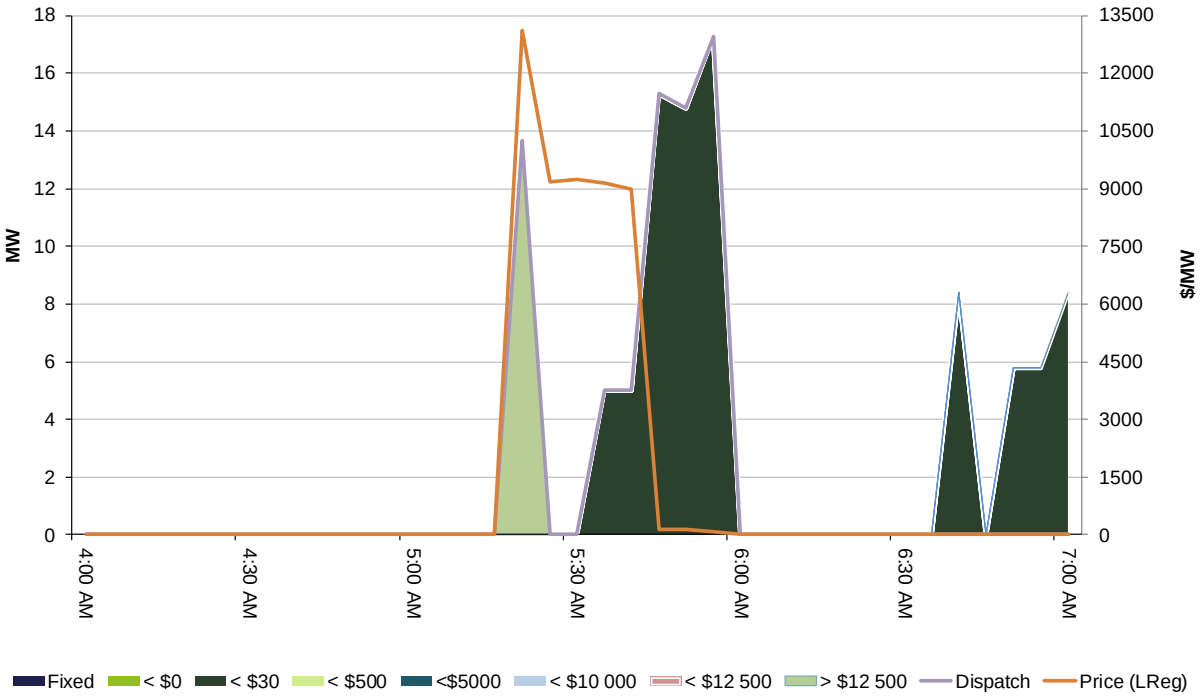


Figure B5a: Northern Power Station (Alinta Energy) lower 60 second service closing bid prices, dispatch and dispatch price for 1 October

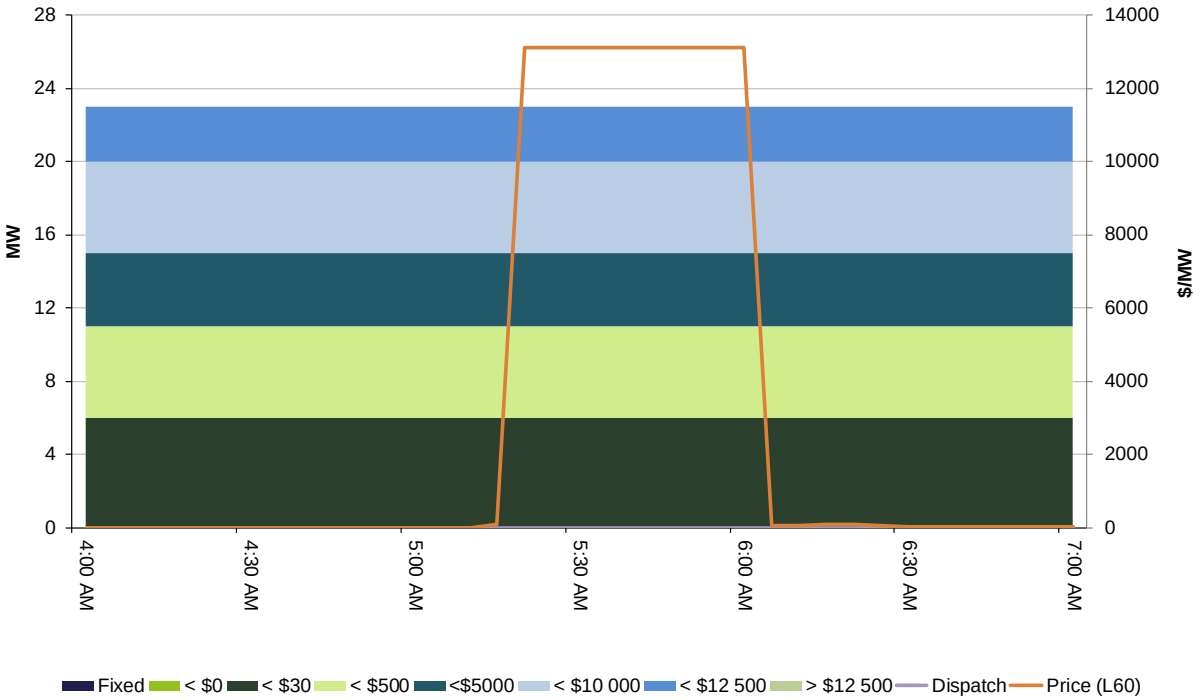


Figure B6b: Northern Power Station (Alinta Energy) lower 60 second service closing bid prices, dispatch and dispatch price for 1 October – effective offers

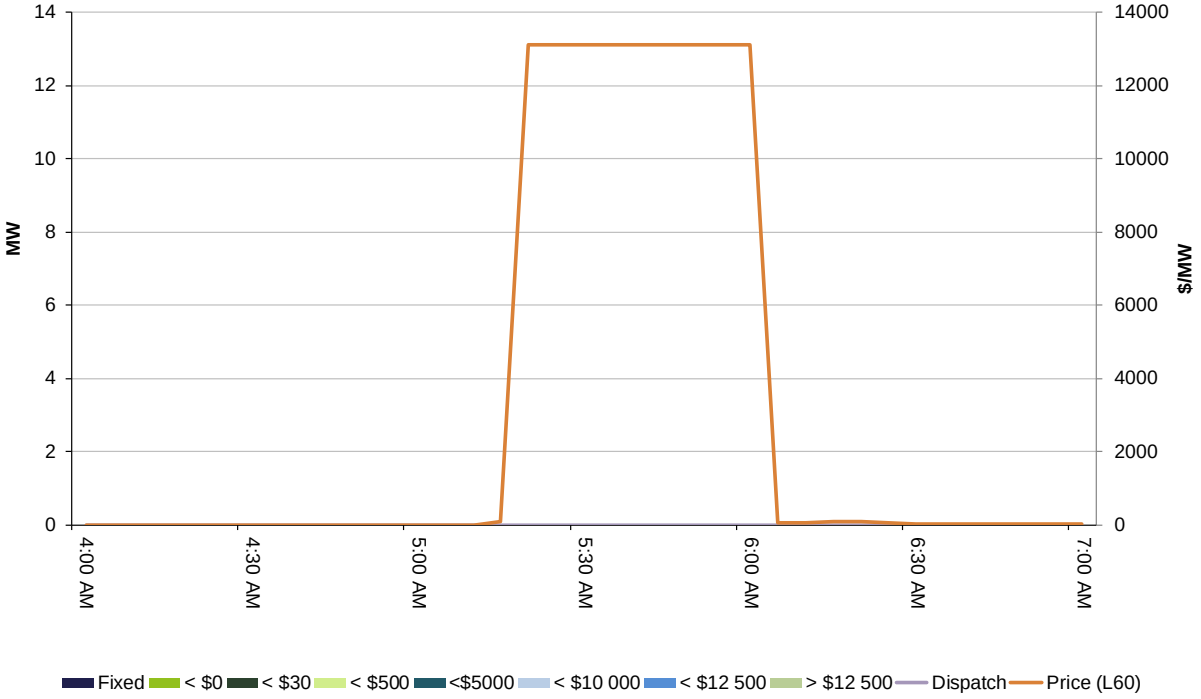


Figure B7a: Northern Power Station (Alinta Energy) lower 6 second service closing bid prices, dispatch and dispatch price for 1 October

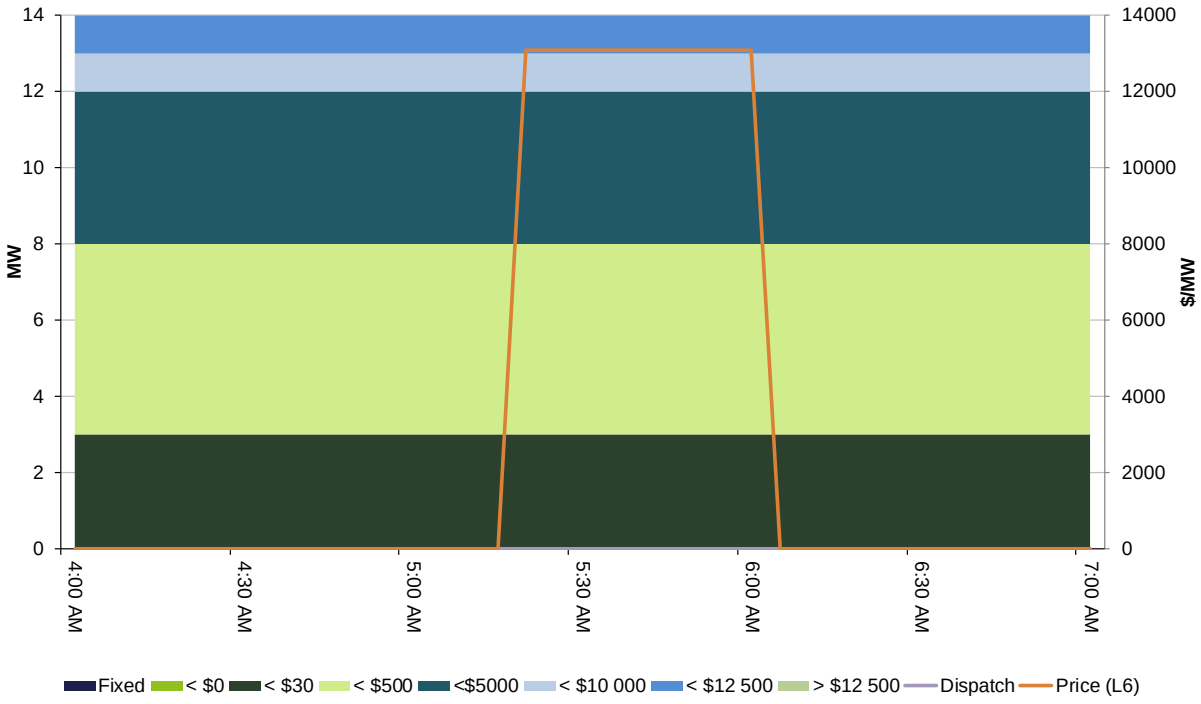


Figure B7b: Northern Power Station (Alinta Energy) lower 6 second service closing bid prices, dispatch and dispatch price for 1 October – effective offers

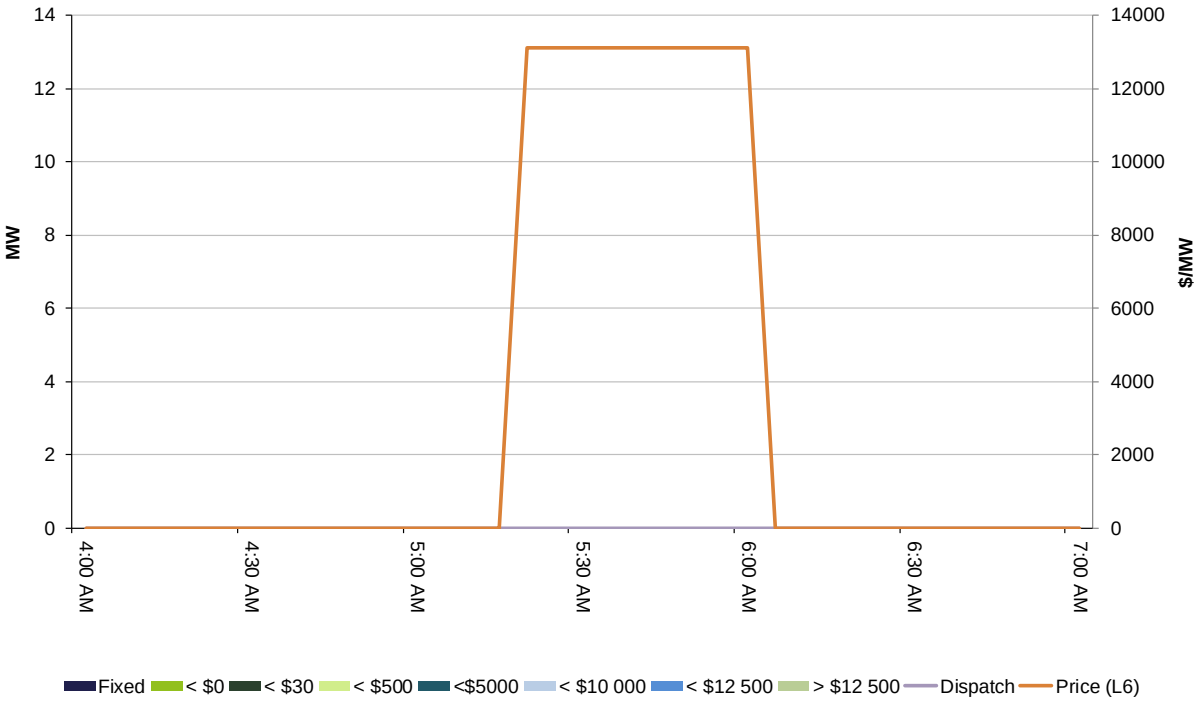


Figure B8a: Northern Power Station (Alinta Energy) lower regulation service closing bid prices, dispatch and dispatch price for 1 October

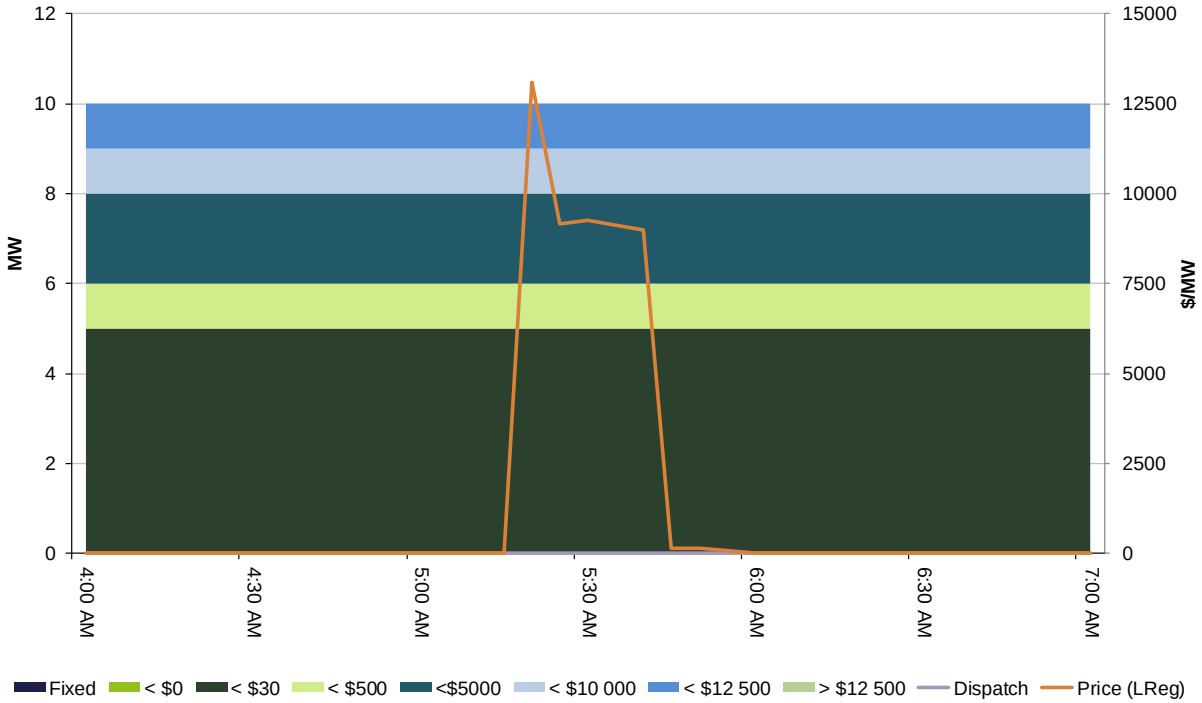


Figure B8b: Northern Power Station (Alinta Energy) lower regulation service closing bid prices, dispatch and dispatch price for 1 October – effective offers

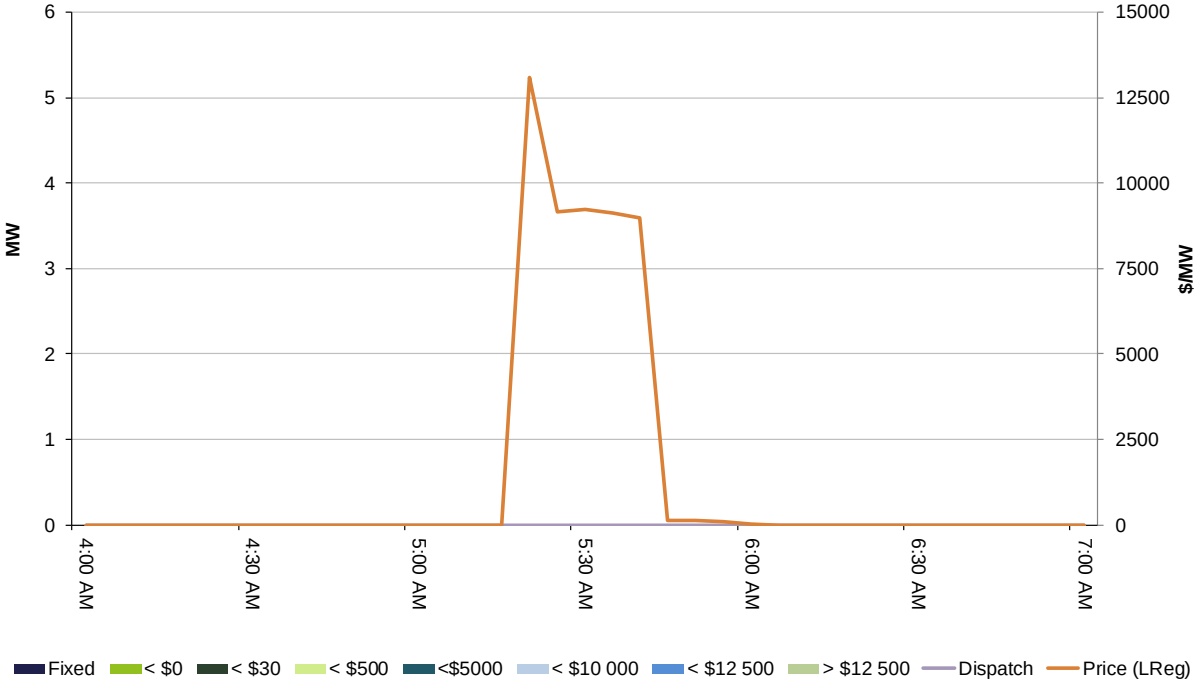


Figure B9a: Pelican Point Power Station (GDF Suez) lower 60 second service closing bid prices, dispatch and dispatch price for 1 October

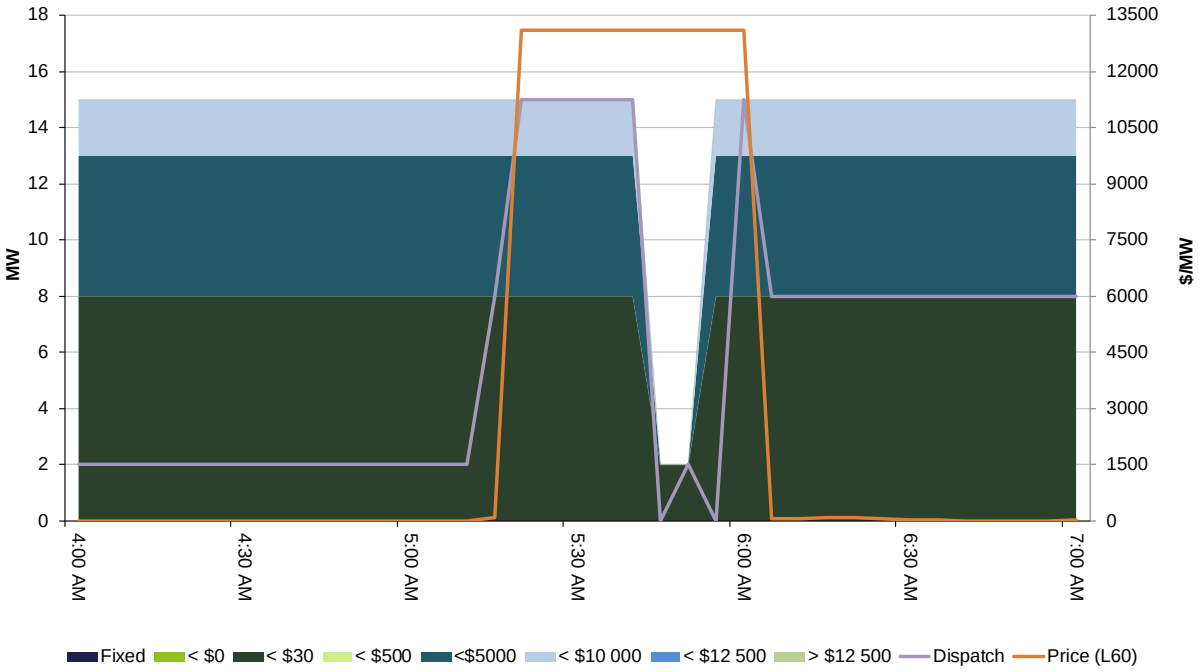


Figure B9b: Pelican Point Power Station (GDF Suez) lower 60 second service closing bid prices, dispatch and dispatch price for 1 October – effective offers

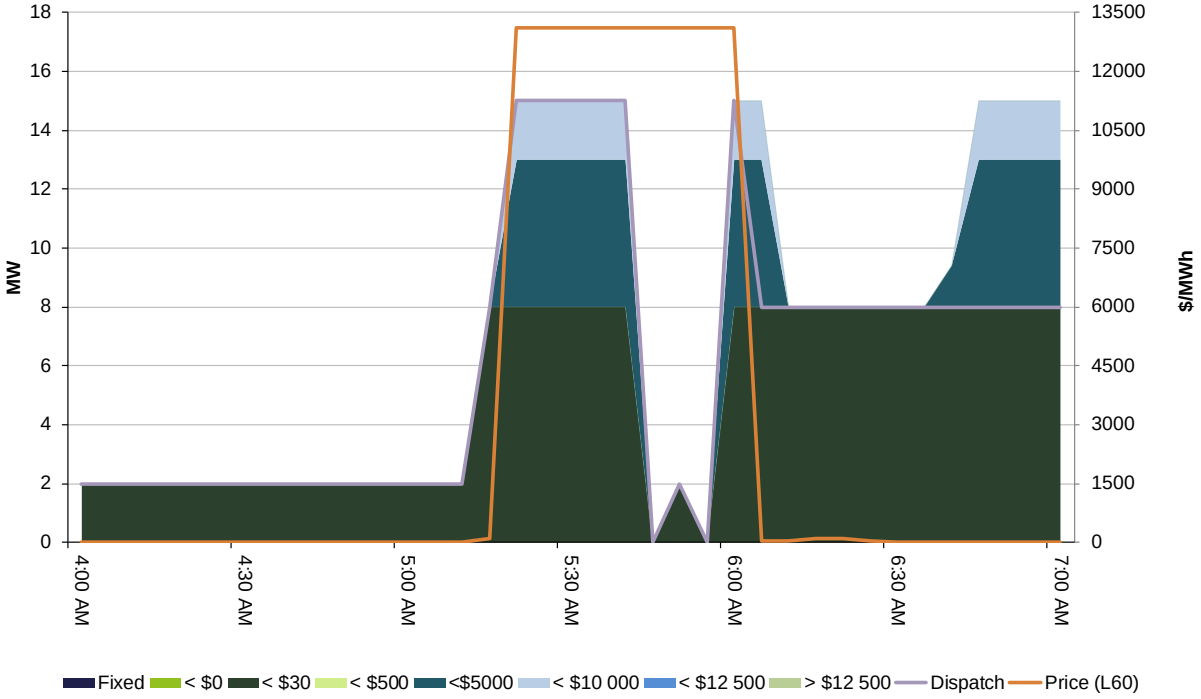


Figure B9a: Pelican Point Power Station (GDF Suez) lower 6 second service closing bid prices, dispatch and dispatch price for 1 October

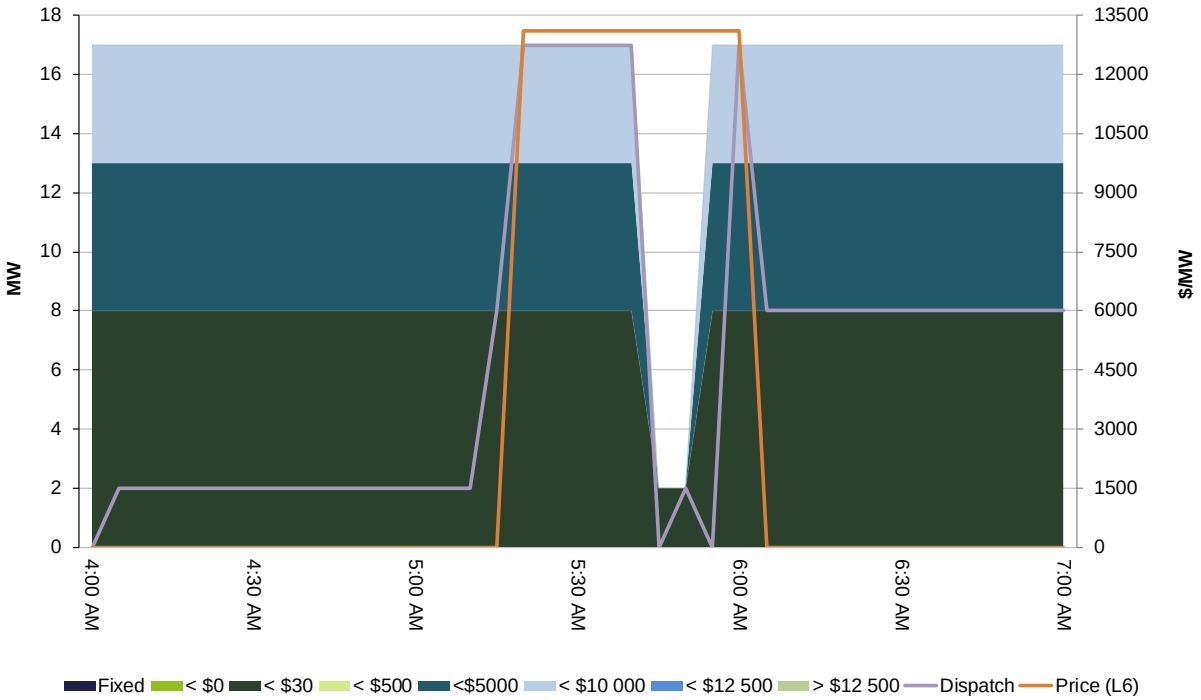


Figure B9b: Pelican Point Power Station (GDF Suez) lower 6 second service closing bid prices, dispatch and dispatch price for 1 October – effective offers

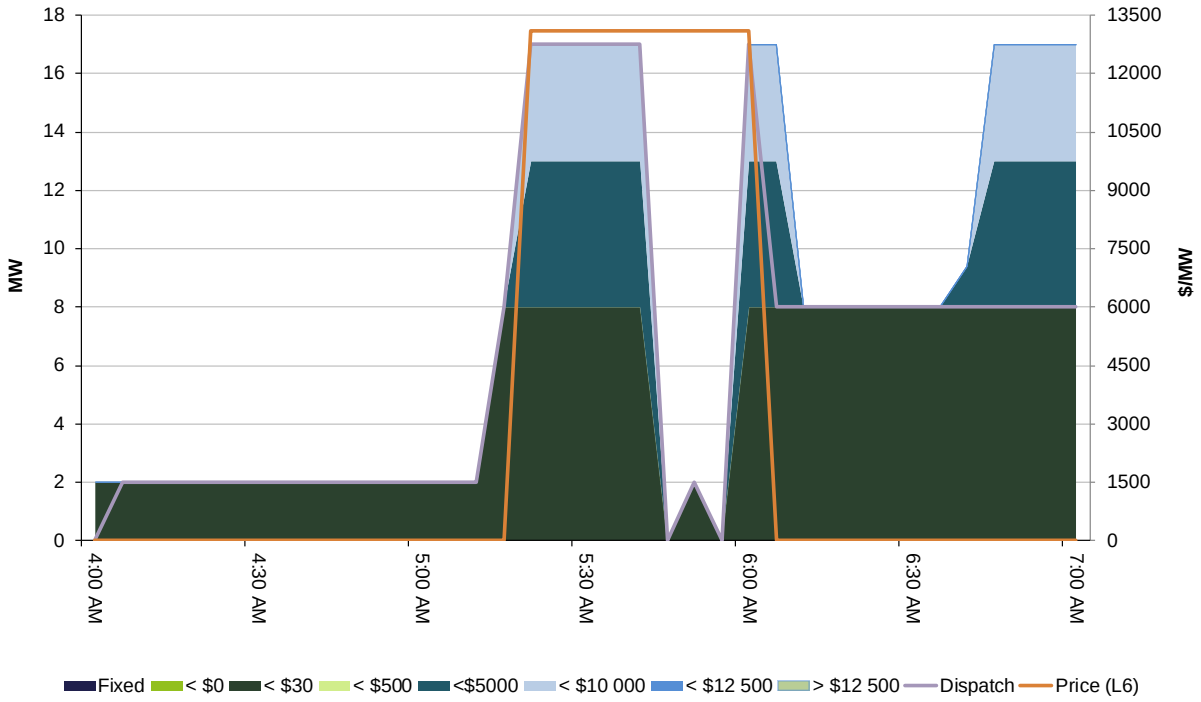


Figure B9a: Pelican Point Power Station (GDF Suez) lower regulation service closing bid prices, dispatch and dispatch price for 1 October

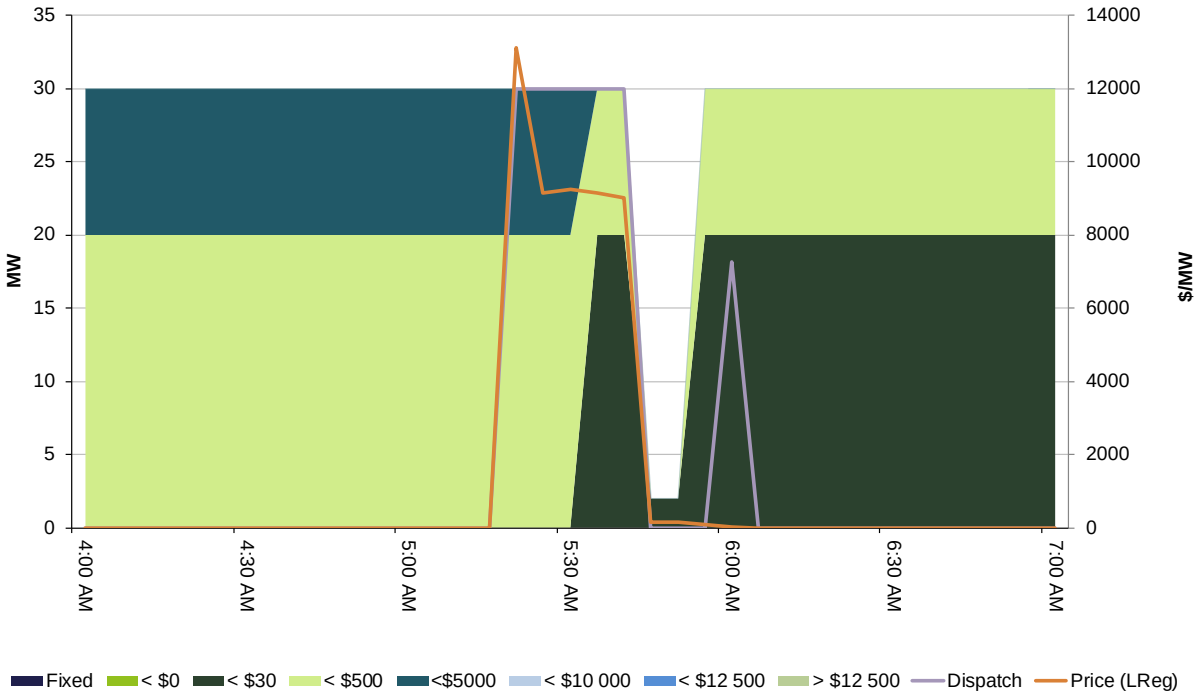
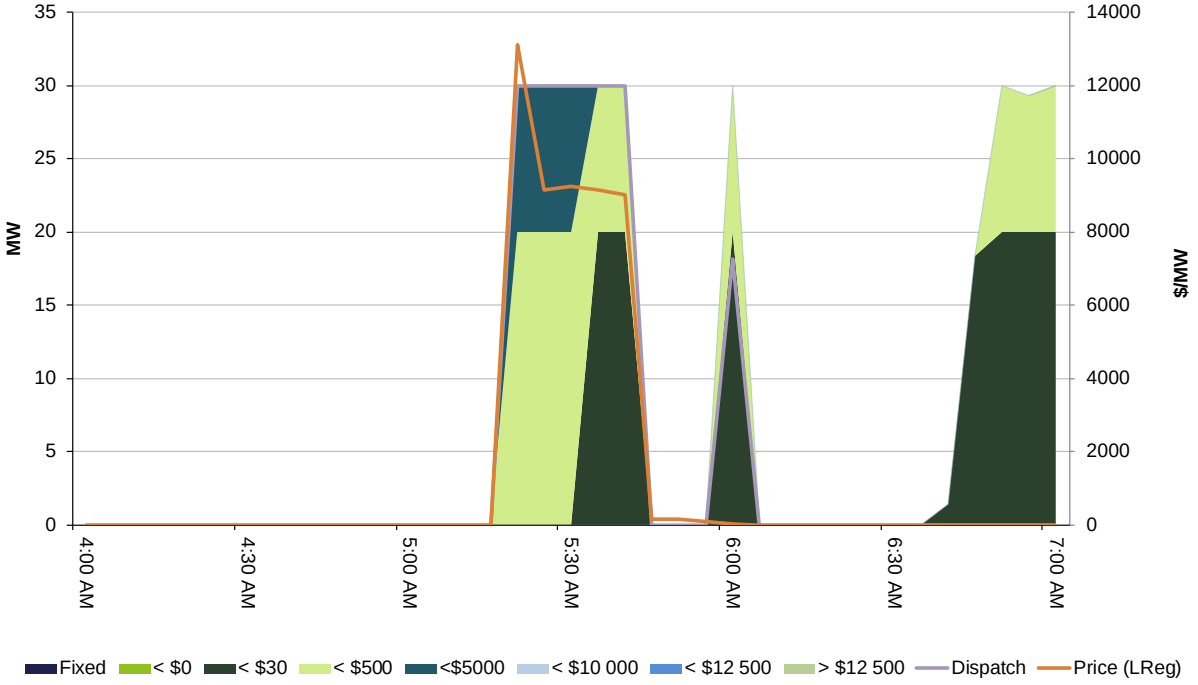


Figure B9b: Pelican Point Power Station (GDF Suez) lower regulation service closing bid prices, dispatch and dispatch price for 1 October – effective offers



Appendix C – 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 types of FCAS:

- Regulation services, which continuously manage small changes in demand or supply (changes that cause the frequency to move by only a small amount away from 50 Hz) to correct the frequency. 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 contingency services to increase the frequency and 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, 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.

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).

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 that result 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 Coordinator. In the case of *South Australia AEMO states*

“the Jurisdictional Coordinator for South Australia has notified AEMO that the frequency band for separation of the South Australian power system is 47 to 52 Hz. … The reliability panel has anticipated 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 previously exporting and the interconnector fails, then local “lower” services are required to lower the frequency (typically generators offer to quickly reduce output to lower frequency). In other words, in the event of a loss of the Heywood interconnector while exporting from

South Australia, the resulting oversupply will lead to an increase in frequency in South Australia. In order to manage this, lower contingency FCAS must be sourced from suppliers in South Australia (typically generators). The requirement for this local lower FCAS is proportional to the flow across the interconnector from South Australia to Victoria.

If the region was previously importing and the interconnector fails, then local “raise” services are required to increase the frequency. Typically generators offer to quickly increase output to raise frequency or, as occurs in South Australia, the frequency will be remedied through involuntarily interrupting customer loads.