NEM – MARKET EVENT REPORT – HIGH FCAS PRICES IN SOUTH AUSTRALIA

OCTOBER AND NOVEMBER 2015

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AEMO
AUSTRALIAN ENERGY MARKET OPERATOR

IMPORTANT NOTICE

Purpose

AEMO has prepared this document to provide information about the high Frequency Control Ancillary Service price periods in October and November 2015, as available at the date of publication.

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EXECUTIVE SUMMARY

ElectraNet's switchgear upgrade at the South East substation in South Australia required multiple planned network outages for the South East – Heywood No.1 and No.2 275 kV transmission lines, in turn, in October and November 2015. During each line outage there was a credible risk of synchronous separation between South Australia (SA) and Victoria (Vic).

AEMO invoked constraint sets during the outages to obtain 35 MW of Regulating Raise and Lower Frequency Control Ancillary Services (FCAS) from within SA, to maintain power system security.

Regulating FCAS prices in SA spiked several times during the outage, which spanned several weeks. These high prices triggered an Administered Price Period three times and resulted in the application of the Administered Price Cap to 19 trading days. The cost of Regulating FCAS in the National Electricity Market (NEM) between 11 October and 10 November 2015 was approximately $27 million. Previously, the average cost of Regulating FCAS for a similar duration in 2015 would have been about $0.47 million.

On 1 November 2015, following a trip of the Heywood No.1 line and the resulting synchronous separation[1] of SA from VIC, Contingency FCAS prices in SA also increased due to increased Contingency FCAS requirements.

The power system is not in a secure operating state unless it will return to a satisfactory operating state following a single credible contingency event (in this case a trip of the remaining Heywood interconnector line). Insufficient availability of Regulating FCAS in SA immediately following a synchronous separation event means that there is, in AEMO's reasonable opinion[2], a risk that this requirement would not be met. AEMO, therefore, determined it was necessary to obtain Regulating FCAS on a pre-contingent basis to keep the power system secure during the outages.

There are only a small number of generating units currently classified as ancillary service generating units and able to provide FCAS in SA. Unless Regulating FCAS is procured in SA when there is a risk of islanding, these facilities can be economically dispatched to zero (i.e. offline) under low demand and high wind conditions.

AEMO has identified that its settlements process did not correctly allocate the cost recovery for local Regulating FCAS during these periods. This is a separate issue from the high FCAS prices themselves, but it is noted in this report because it affected how those costs were allocated between Market Participants in SA. AEMO has implemented a solution to amend the settlements logic to correct this allocation and is currently in the process of issuing special revisions for the affected billing weeks.

AEMO also intends to review the 'Causer Pays' Procedure in consultation with stakeholders in 2016 to consider whether it remains appropriate. This is the procedure used to determine the contribution factors that underpin the allocation of Regulating FCAS costs to Generators and Market Customers with major loads based on the degree to which they cause frequency deviation in the NEM, and the residual contribution factor, which is the basis for allocation to the remaining Market Customers.

[1] The Murraylink Interconnector remained in service when the Heywood Interconnector tripped. The Heywood Interconnector is the only link that provides synchronous connection between SA and the rest of the NEM.

[2] The NER 4.2.4 states that the power system is in a secure operating state if, in AEMO's reasonable opinion, the power system is in a satisfactory operating state, and the power system will return to a satisfactory operating state following the occurrence of any credible contingency event. This clause also specifies matters that AEMO must consider when forming its opinion.

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1. SCOPE OF THIS REPORT

This market event report is limited to analysing the high FCAS price periods between 11 October 2015 and 10 November 2015.

This report does not review power system operation for the loss of the Heywood interconnector and the resulting under-frequency load shedding (UFLS) in SA on 1 November 2015. That will be covered in a separate AEMO Power System Operating Incident Report (a “reviewable operating incident” report) that AEMO is required to produce under National Electricity Rules (NER) clause 4.8.15.

2. BACKGROUND

2.1 SA Interconnection

South Australia's transmission network is connected to the rest of the National Electricity Market (NEM) via the Murraylink and Heywood Interconnectors. These Interconnectors allow electricity to flow between South Australia and Victoria.

The Murraylink Interconnector is a direct current (DC) link that connects SA to North-West Victoria via the Riverland region, with a nominal transfer capability of 220 MW.

The Heywood Interconnector is an alternating current (AC) link that connects SA to South-West Victoria and is comprised of two 275 kV transmission lines (South East – Heywood No.1 and No.2 275 kV lines) that connect the South East substation in SA and the Heywood Terminal Station in Victoria. The Heywood Interconnector is the only link that provides synchronous connection between SA and the rest of the NEM.

2.2 Switchgear upgrade at South East Substation

ElectraNet is upgrading the switchgear at the South East Substation in SA. This project involves installation of three new 275 kV circuit breakers (CBs) to provide bus ties between the South East 275 kV North and South Buses.

ElectraNet submitted multiple planned outage requests for the project, including the Heywood Interconnector outages in October and November 2015. During each Heywood Interconnector line outage, the risk of synchronous separation between SA and VIC is considered to be a credible contingency event in accordance with the re-classification process referred to in clause 4.2.3 of the NER.

2.3 FCAS availability in SA

AEMO manages the credible risk of separation between regions by enabling sufficient FCAS[3] in the relevant region or regions to respond to frequency disturbances and to ensure that the power system would return to a satisfactory operating state following a separation event[4].

For the period analysed in this report, there were three providers of FCAS in SA. These were Northern, Pelican Point and Torrens Island Power Stations[5].

2.4 FCAS requirements in SA

2.4.1 Contingency FCAS requirement

The Reliability Panel determines the power system frequency standards in the NEM, which are used to determine the amount of FCAS required at all times. The Reliability Panel determined in 2001 that the frequency standard for separation events in the NEM be modified from the previous standard of 47 to 52 Hz to 49 to 51 Hz unless the relevant Jurisdictional System Security Coordinator (JSSC) notified AEMO otherwise.

The SA JSSC notified AEMO (NEMMCO at the time) in 2001 that the frequency band that applies to any event that may cause substantial separation[6] of the SA power system would remain at 47 to 52 Hz.

[3] Information about FCAS markets is provided in the 'Guide to Ancillary Services in the National Electricity Market' at http://www.aemo.com.au/Electricity/Market-Operations/Ancillary-Services.
[4] See NER clause 4.2.4 for the definition of a secure operating state.
[5] Northern, Pelican Point and Torrens Island Power Stations are owned by Alinta Energy, Pelican Point Power and AGL, respectively. Torrens Island comprises Torrens Island A Station and Torrens Island B Station.
[6] For SA, a substantial separation is one that separates supply to Adelaide from the rest of the NEM.

This wider frequency band in SA allows the use of under-frequency load shedding facilities to be used to maintain the power system in a satisfactory operating state post separation, therefore the pre-contingent procurement of Contingency[7] Raise FCAS in SA is not required at times of credible separation.

2.4.2 Regulating FCAS requirement

The normal operating frequency band for the mainland regions in the NEM is 49.85 to 50.15 Hz. During island operation (where all or part of a region is electrically separated from the rest if the NEM) the frequency band is slightly wider at 49.5 to 50.5 Hz. Appendix A describes how Regulating FCAS is used to regulate frequency in SA it is operating as an island.

Prior to October 2015, Regulating FCAS would be sourced within SA after separation to to regulate frequency within the power system frequency standard for an SA island. This was possible because there would be enough SA-based generation online to provide it immediately following a separation.

The Regulating FCAS requirement for an SA island operation has changed over time. From 2003 to 2004, a variable requirement of between 50 and 150 MW was used. From 2004, a fixed requirement of 70 MW was used. AEMO reviewed this requirement following a joint review on the renewable energy integration in SA in 2014 with ElectraNet[8]. In January 2015, AEMO updated its procedures to lower the maximum Regulating FCAS requirement in SA from 70 MW to 35 MW for Raise and Lower Services following a SA islanding event[9].

The AEMO-ElectraNet analysis in 2014 was based on the assumption that there would not be enough generation online to provide Regulating FCAS immediately following a SA islanding event. This assumption was necessitated by a change in the generation mix in SA[10].

The AEMO-ElectraNet analysis recommended that AEMO ensure there was sufficient generation online in SA with the ability to control frequency prior to separation and establish new arrangements for monitoring the availability of Regulating FCAS in SA, for use when there was a credible risk of separation.

2.4.2.1 AEMO's obligation under the NER

AEMO is required to use its reasonable endeavours to operate the power system so that it is and will remain in a secure operating state in accordance with NER clause 4.2.6. The power system is secure when it is in a satisfactory operating state, and will return to that state following the occurrence of any credible contingency event, in accordance with the power system security standards (see NER 4.2.4).

AEMO determined that in the event of loss of the Heywood Interconnector (a credible contingency event during the outage periods), the power system would not remain in a satisfactory operating state if Regulating FCAS was not available immediately after a separation event.

If the available Regulating FCAS is insufficient in SA immediately following a synchronous separation event to return the islanded region to the standard operating frequency band, the power system will not return to a satisfactory operating state. On that basis, the power system would not be in a secure

[7] Contingency FCAS includes all types of FCAS other than Regulating FCAS (per NER 3.11.2(a)).

[8] In 2014, AEMO and ElectraNet conducted a study on renewable energy integration in SA. The study analysed power system frequency control in SA, particularly under conditions when the SA power system is or could become separated from the rest of the NEM. The findings, published in October 2014 (http://www.aemo.com.au/Electricity/Planning/Integrating-Renewable-Energy), highlighted a need for AEMO to improve its ability to assess available frequency control capability for planned outages of the Heywood Interconnector. In 2014/15, AEMO reviewed the FCAS availability in SA and the amount of FCAS required under different scenarios.

[9] The reduction from 70 MW to 35 MW is based on analysis of the short term MW variations in the Heywood interconnector flow. For the analysis, AEMO monitored the Heywood tie-line MW flow variation for system conditions with no local Regulating FCAS enabled in SA, unchanging Heywood dispatch targets, and various levels of renewable generation (high, med, and low SA wind generation). 35 MW was determined to be the typical 'Regulating Service' provided via the Heywood interconnector.

[10] The change in the generation mix in SA is discussed in the AEMO-ElectraNet study (website link provided in footnote 7): The NEM was designed to function with synchronous generation (predominantly coal and gas-fired generation, and some hydro generation) that was capable of providing power system frequency and voltage control. Synchronous generation in SA is being displaced by non-synchronous generation, i.e. wind and solar generation, which is intermittent.

operating state during the outages. AEMO, therefore, determined that it was necessary to procure Regulating FCAS on a pre-contingent basis to keep the power system secure during the outages.

3. SOUTH AUSTRALIA AT RISK OF ISLANDING

ElectraNet submitted requests in June 2015 for a series of outages of the South East – Heywood 275 kV transmission lines commencing on 11 October 2015 for the South East CB upgrade project. During the outages, loss of the Heywood Interconnector followed by synchronous separation between SA and VIC would be a credible contingency event.

AEMO is required to approve an outage if, based on information available at the time of the assessment[11], power system security and reliability could be maintained during the outage.

AEMO determined that the outages would not create any power system reliability issues.

AEMO considered that power system security would be impacted if the available Regulating FCAS was insufficient.

AEMO assessed the available Regulating FCAS capability in SA for the first outage commencing on 11 October 2015 during the Short Term Projected Assessment of System Adequacy (ST PASA) timeframe[12]. AEMO considered the following factors in its assessment:

- Pelican Point Power Station was expected to be offline (bid unavailable) during the first outage.
- FCAS providers in SA were, therefore, limited to Northern and Torrens Island Power Stations.
- 35 MW of Raise and Lower Regulating FCAS was required in SA if SA were to be islanded.
- Northern Power Station provides a maximum of 20 MW of Regulating Raise or Lower FCAS.
- Torrens Island Power Station can provide enough Regulating FCAS to meet the SA requirements (more than 35 MW).
- The FCAS providers in SA needed to be online to supply FCAS.
- The FCAS providers in SA could be offline under low demand and high wind conditions.

AEMO considered the following options:

- Procuring 35 MW of Regulating FCAS in SA following the separation: Not suitable, as it might not have been possible to procure sufficient Regulating FCAS immediately following separation and there would be a material risk of the power system not returning to a satisfactory operating state following separation. This risk arises because there were no means of regulating frequency within the island until Regulating FCAS could have been enabled using AEMO's AGC system, which can take in excess of two dispatch intervals (DIs) to be completed.
- Invoking Regulating FCAS constraint equations only when the Regulating FCAS availability fell below 35MW: Not suitable as it provided inconsistent market signals (if 35MW became available after the constraint equations were invoked, revoking them could mean it might then become unavailable). It is not practicable for the AEMO control room to monitor FCAS availability continuously for extended periods.
- Contract for Regulating FCAS as a non-market ancillary service: Not as the acquisition of non-market ancillary services does not appear to be open to AEMO under the NER in its capacity as system operator.
- Reject the outage request: Not appropriate, as AEMO cannot prohibit an outage unless power system security or reliability would be put at risk by the outage and the risk cannot be managed through normal market processes. Procurement of FCAS by invoking network or FCAS constraint sets is a normal market process that can be used by AEMO to manage power system security risks.

[11] The outage assessment processes and AEMO's obligations under the NER are provided in the Outage Assessment Procedure – SO_OP_3718 (http://www.aemo.com.au/Electricity/Policies-and-Procedures/System-Operating-Procedures/Outage-Assessment-SO_OP_3718).
[12] Outage assessment for the ST PASA timeframe is performed within 1 week from the outage commencement time.

- Relying on direction of a Regulating FCAS provider following separation: Ineffective if the relevant generating unit is offline as it takes more than 30 minutes for it to restart and provide the required FCAS. Furthermore, the use of directions under the NER is intended to be a last resort if market response fails (see NER 4.8 generally).

To do nothing was not even considered a viable option.

AEMO concluded that the risk of the entire SA power system blacking out due to large frequency variations that could not be contained if insufficient Regulating FCAS was available in SA immediately following SA separation was credible.

On the basis of this assessment, AEMO determined on 8 October 2015 that the power system would not be secure during the outage unless 35MW of Raise and Lower Regulating FCAS was available on a pre-contingent basis. As a result, constraint sets (F-S_LREG_0035 and F-S_RREG_0035) were invoked for the duration of the outage.

The constraint equations in these constraint sets were developed in accordance with the Constraint Formulation Guidelines[13]. These constraint sets were invoked in addition to the Contingency FCAS constraint set for the outage (F-I-HYSE). This decision was communicated to the market via the Network Outage Scheduler (NOS) on 8 October 2015 by attaching the constraint sets to the planned outage in NOS.

In response to enquiries from participants after the outage commenced and high Regulating FCAS prices were observed (some hours after the outage commenced – see Appendix B), AEMO issued a Market Notice (MN) No.50003 on 12 October 2015 to provide the reason for invoking the Regulating FCAS constraint sets. AEMO acknowledges stakeholder feedback that earlier notice would have enabled Market Participants to better assess the potential market impact.

For each subsequent planned outage for the South East CB upgrade project, AEMO performed a similar assessment and determined to invoke the SA Regulating FCAS constraint sets.

The transmission line outages for the South East CB upgrade project are summarised in Table 1.

Table 1 Line outage period

South East – Heywood line	Start	End
No. 2	1045 hrs 11 October 2015	1739 hrs 13 October 2015
No. 1	0730 hrs 15 October 2015	1039 hrs 26 October 2015
No. 2	0705 hrs 29 October 2015	1730 hrs 10 November 2015

AEMO met with interested participants on 7 December 2015 to discuss AEMO's decision-making process and related analysis for this event.

[13] The Constraint Formulation Guidelines are available at: http://www.aemo.com.au/Electricity/Market-Operations/Ancillary-Services/Guides-and-Descriptions/Constraint-Formulation-Guidelines.

4. SOUTH AUSTRALIA ISLANDED

On 1 November 2015, during a planned outage of the South East – Heywood No.2 275kV line, the South East - Heywood No.1 275 kV transmission line tripped at the South East end, resulting in separation of SA from the rest of the NEM and approximately 160 MW of load was shed in SA.

It is important to note that the 35 MW of Regulating FCAS in SA (as discussed in Section 3) was not procured to reduce the likelihood of a separation event, or to avoid load shedding during such an event. Rather, it was procured pre-contingent to ensure that the power system would return to a satisfactory operating state post-contingency after a separation event.

During the separation, AEMO invoked the SA separation constraint sets (SA_ESTN_ISLE, F-SA_ISLE, F-ESTN_ISLE and F-SA_ESTN_ISLE_REG). The constraint set F-SA_ESTN_ISLE_REG managed the Regulating FCAS requirements within SA and the rest of the NEM. The Regulating FCAS requirements for SA remained at 35MW and the Contingency FCAS requirements were increased in SA during the separation.

AEMO is separately preparing a “reviewable operating incident” report to discuss the operation of the power system during the separation event.

5. MARKET OUTCOMES

5.1 Pricing Outcomes

The high FCAS prices in SA between 11 October 2015 and 10 November 2015 were determined through normal market processes as the marginal value of procuring the 35 MW of Regulating FCAS in SA. The limited number of facilities that could provide FCAS in SA resulted in high FCAS prices.

AEMO publishes pricing event reports for unusual pricing outcomes in the NEM. The current reporting threshold for unusual FCAS prices in SA is $150/MWh for the sum of all FCAS half-hourly average prices in the region. Between 11 October 2015 and 10 November 2015, a total of 1,027 trading intervals (TIs) exceeded the reporting threshold. This includes 16 days where the prices were above the reporting threshold for the entire day. AEMO has published several pricing event reports covering each outage period[14].

Appendix B displays Regulating FCAS prices in SA during the outage period. It shows that the high prices started some hours after the outage commenced and the prices fluctuated during the outage period.

Based on an historical average in 2015, the expected Regulating FCAS cost for the total quantity of FCAS required in the NEM between 11 October and 10 November 2015 would have been around $0.47 million[15]. The actual cost during this event was approximately $27 million[16]. The majority of the actual costs were to be recovered from Market Participants with facilities in SA.

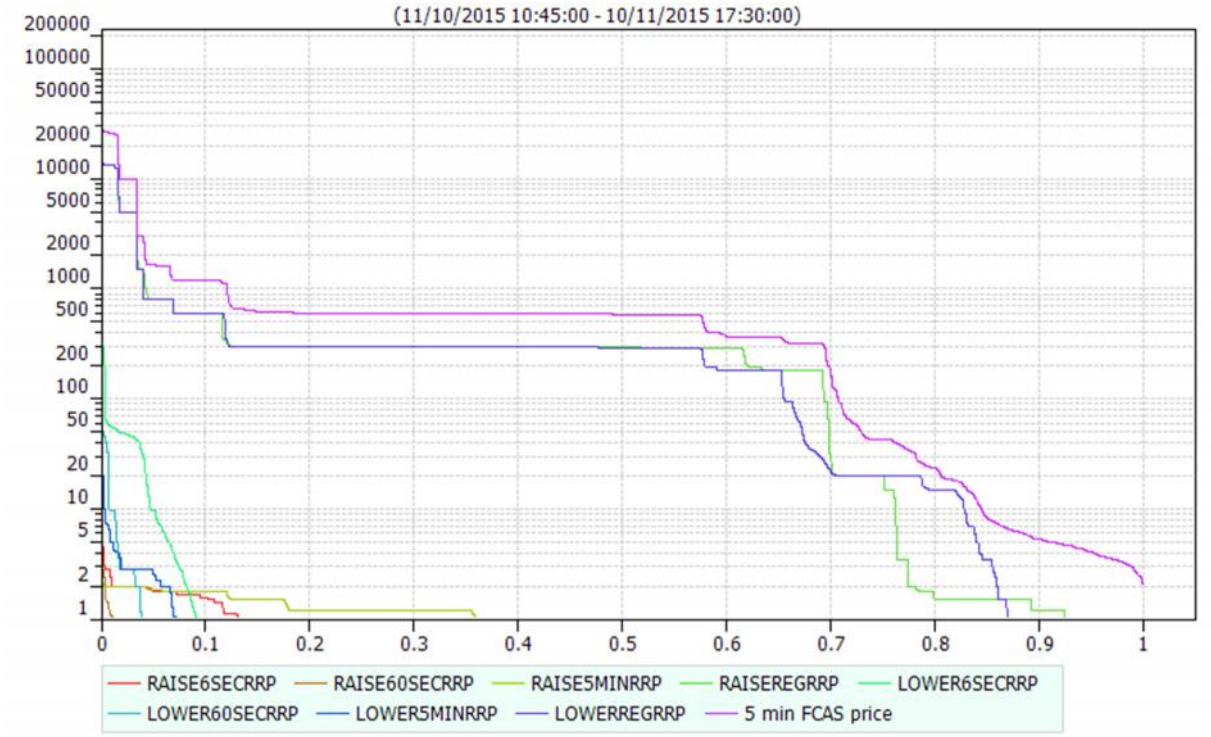
Figure 1 shows the price duration curve for all FCAS in SA between 11 October 2015 and 10 November 2015. For more than 58% of the period, the Regulating FCAS prices for both Raise and Lower services were above $200/MWh.

[14] Pricing Event Report - October 2015 and November 2015. Available from: http://www.aemo.com.au/Electricity/Resources/Reports-and-Documents/Pricing-Event-Reports.

[15] The Regulating FCAS cost is the sum of Raise and Lower Regulating FCAS costs. The average cost is based on the settlement data published at AEMO's website (http://www.aemo.com.au/Electricity/Data/Ancillary-Services/Ancillary-Services-Payments-and-Recovery). The average cost calculation is based on the 2015 data from billing Week 1 to Week 41.

[16] The actual cost is based on the Week 42 to Week 46 data. For the three days between 8 and 10 November 2015, the cost is estimated based on the data from the billing Week 46 (as the Week 46 data provides the cost for 7 days), with a consideration that the high FCAS costs occurred only on 10 November 2015 during that week.

Figure 1 FCAS price duration curve



5.2 Administered Price Cap in South Australia

An administered price period (APP) for a region is triggered automatically when the rolling sum of any FCAS price over the previous 2016 DIs (i.e. seven days) exceeds six times the cumulative price threshold (CPT) [17]. Administered price conditions are independently assessed and triggered for each region of the NEM[18].

The rolling sum of each FCAS price in SA between 11 October 2015 and 10 November 2015 is shown in Figure 2, along with the CPT. The prolonged high Regulating FCAS prices resulted in the rolling sum of either Raise or Lower Regulating FCAS prices exceeding six times the CPT of $207,000 (6 x $207,000 = $1,242,000). As a result, APP was triggered three times impacting 19 trading days between 11 October 2015 and 10 November 2015. The administered price cap (APC) of $300/MWh was applied to all FCAS prices in SA for the periods listed in Table 2.

[17] For FCAS, six times the CPT is used as per the NER requirement.
[18] Operation of the Administered Price provisions in the National Electricity Market. 2 July 2015. Available from: http://www.aemo.com.au/Electricity/Market-Operations/Dispatch/Administered-Price-Provisions-in-the-NEM.

Figure 2 Rolling sum of each FCAS uncapped price in South Australia

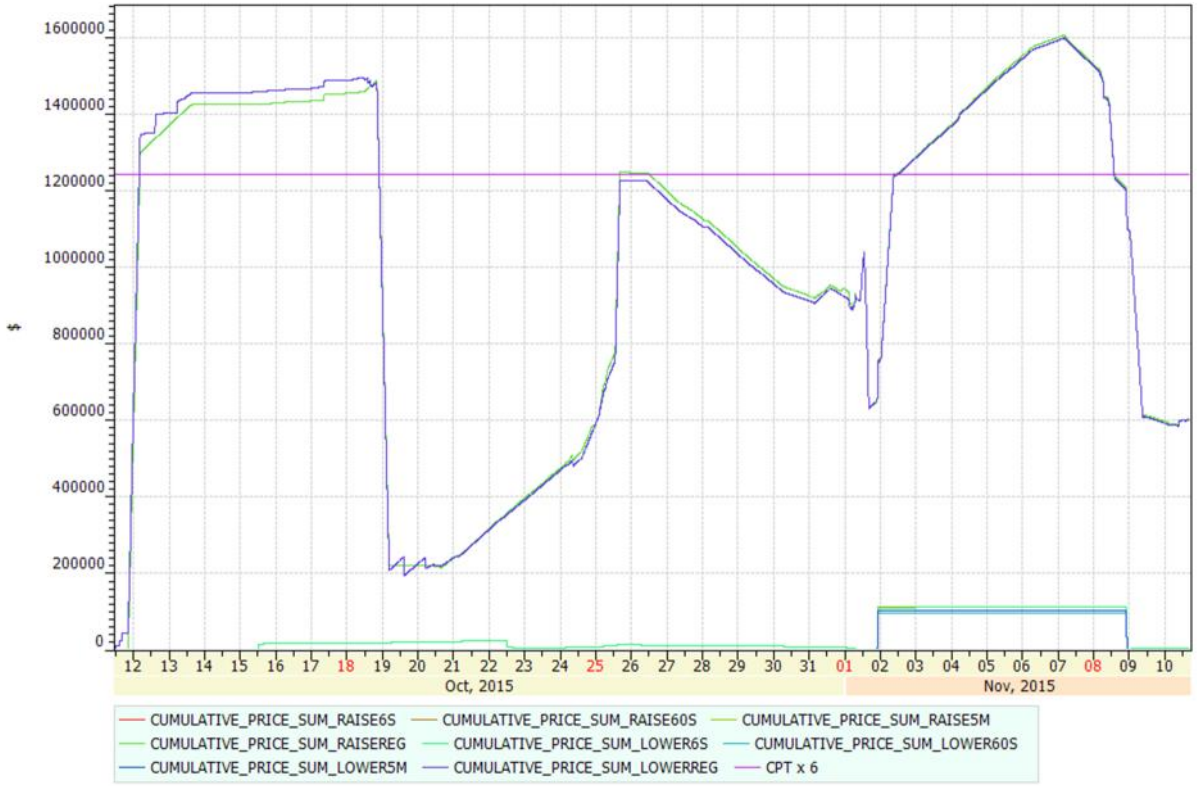


Table 2 Administered Price Periods

Start	Market Notice	End	Market Notice
12 October 2015 DI ending 0405 hrs	49997	19 October 2015 DI ending 0400 hrs	50082
25 October 2015 DI ending 1620 hrs	50172	27 October 2015 DI ending 0400 hrs	50201
2 November 2015 DI ending 0905 hrs	50270	9 November 2015 DI ending 0400 hrs	50398

The FCAS and number of DIs impacted during the APP are summarised below. These Services had prices ranging between $300/MWh and MPC before they were capped at the APC of $300/MWh.

- Fast Lower Service – 10 DIs.
- Lower Regulating Service – 114 DIs.
- Raise Regulating Service – 84 DIs.

AEMO's automated system automatically ceases the APP at 0400 hrs (i.e. end of the trading day) if at that time the cumulative price (as calculated from dispatch prices without capping) is less than the CPT.

5.3 Generator bidding

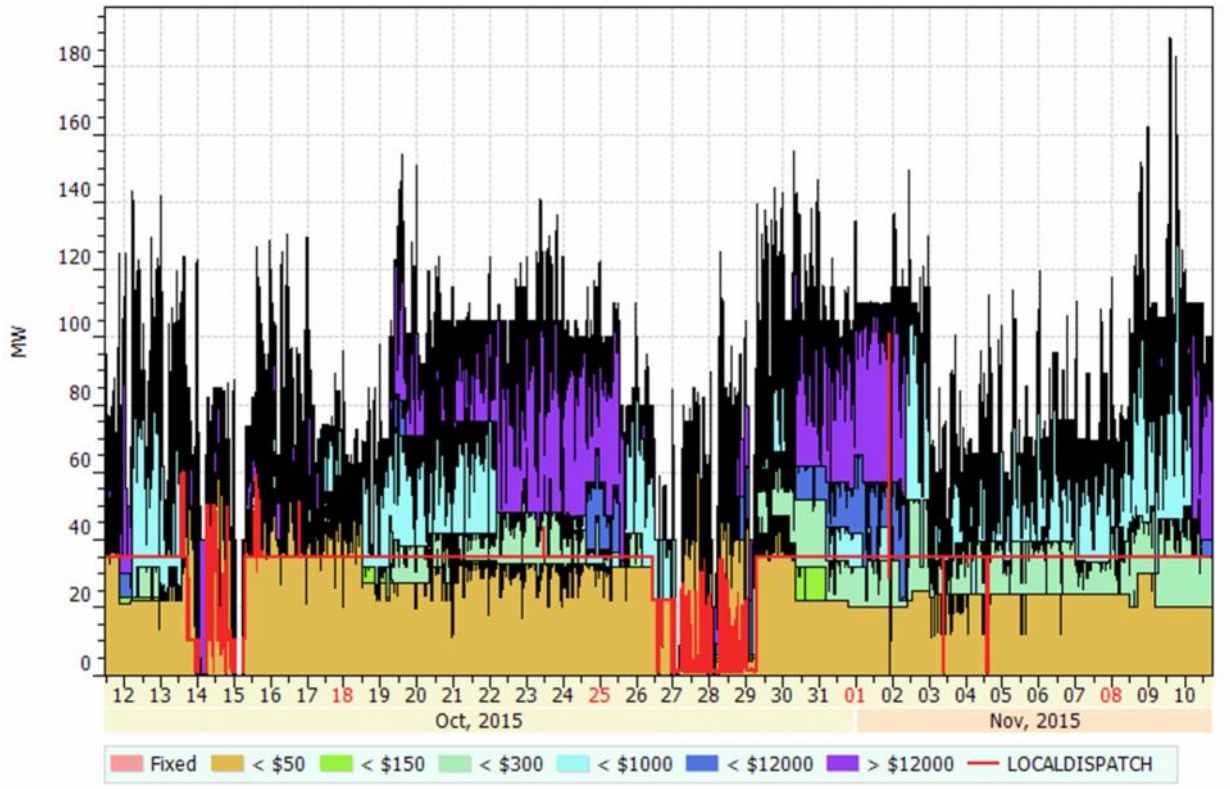
Figures 3 and 4 show the Generator bids for Raise and Lower Regulating FACS as well as the enablement amount of each service (LOCALDISPATCH) between 11 October 2015 and 10 November

2015. In these charts, the bids are adjusted by actual availability[19] as opposed to the bid Maximum Availability. The actual availability fluctuates constantly as a unit's generation output changes. This frequent change forms thick black lines in the graphs. These charts are analysed further in Appendix C.

For Raise Regulating FCAS bids during the outage periods, an average of 38% were offered in bands priced below $150/MWh. Of the 35 MW of pre-contingent Raise Regulating FCAS required, on average 30 MW was offered in bands priced below $150/MWh.

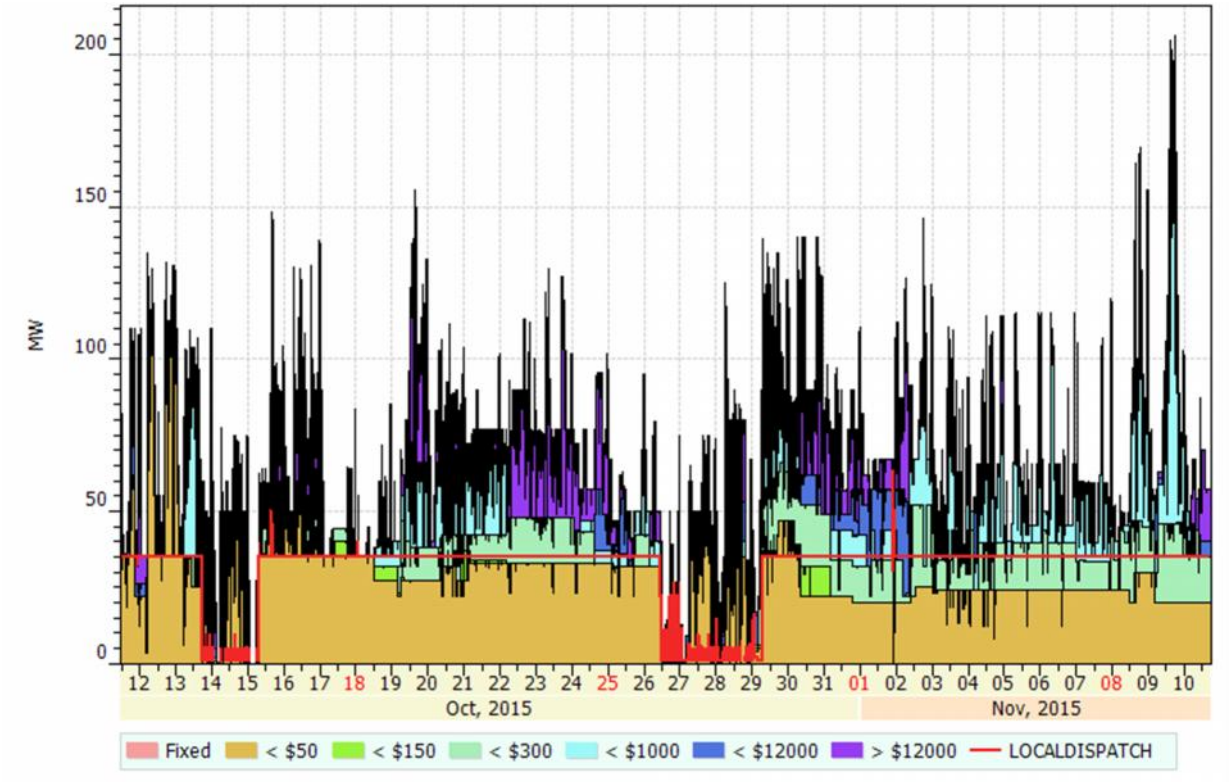
For Lower Regulating FCAS bids during the outage periods, an average of 50% were offered in bands priced below $150/MWh. Of the 35 MW of pre-contingent Lower Regulating FCAS required, an average of 31 MW was offered in bands priced below $150/MWh.

Figure 3 Raise Regulating bids adjusted by actual availability in South Australia



[19] The bid amount is adjusted based on each Generator's generation profile. In cases when Generators are not operating within the FCAS offer profile, the bid will be 0 MW.

Figure 4 Lower Regulating bids adjusted by actual availability in South Australia



5.3.1 Rebids prior to APP

Northern and Torrens Island Power Stations' Regulating FCAS capacity was shifted from low-priced bands to high-priced bands during the outage periods, setting the Regulating FCAS prices high in SA. The bids with the largest impact on the cumulative price between 11 October 2015 and 10 November 2015 are analysed below:

- For DI ending 2025 hrs on 11 October 2015, 60 MW of Raise Regulating and 60 MW of Lower Regulating FCAS from Torrens Island A units was rebid from bands priced at or below $500/MWh to bands priced at $13,100/MWh. Each 30-minute Lower and Raise Regulating FCAS price increased to $13,100/MWh or above from TI ending 2100 hrs on 11 October 2015 until 0400 hrs on 12 October 2015. The prolonged high Regulating FCAS price triggered the first APP.
- For DI ending 1310 hrs on 25 October 2015, 10 MW of Raise Regulating and 10 MW of Lower Regulating FCAS capacity from Northern Unit 2 was rebid from bands priced at $1,499.79/MWh to $12,399.79/MWh[20]. Pelican Point had withdrawn its Regulating FCAS capacity from the market (30 MW of Raise Regulating and 30 MW of Lower Regulating FCAS capacity) from DI ending 1245 hrs[21]. Subsequent to the event, Pelican Point has informed AEMO that the Power Station was decommitted due to suboptimal market outcomes as a result of an oversupply of generation in SA, which saw energy spot prices forecast to outturn at negative levels. Between TIs ending 1330 hrs and 1630 hrs, 30-minute Lower and Raise Regulating FCAS prices ranged between $7,050/MWh and $13,111.20/MWh. The prolonged high Regulating FCAS price triggered the second APP.
- On 2 November 2015, there were no rebids triggering price spikes. Between TIs ending 0100 hrs and 0900 hrs, 30-min Raise and Lower Regulating FCAS prices ranged between

[20] Rebid reason: 1300~F~FCAS ENERGY OPTIMISATION~
[21] Rebid reason: 1235A AVOID UNECONOMIC DISPATCH: ADJUST OOS PROFILE SL

$9,982.07/MWh and $9,985.06/MWh. The high prices were due to limited Regulating FCAS availability in SA. The prolonged high Regulating FCAS prices triggered the third APP.

5.4 Interconnector flows

During the outage periods, the target flow on both Heywood and Murraylink Interconnectors was predominantly towards South Australia.

5.5 Settlements Impact

AEMO settles the FCAS markets each week. In accordance with the NER, FCAS costs are recovered as follows:

- Contingency FCAS: Generators pay for Raise Services and Market Customers pay for Lower Services.
- Regulating FCAS: Cost recovery on a "causer pays" basis using the Causer Pays Procedure[22] developed by AEMO following consultation in accordance with the NER consultation procedures (NER 8.9).

The high Regulating FCAS prices experienced in SA during the outages are recovered from Market Participants with facilities or loads in SA, as the high prices were related to Regulating FCAS requirements for SA only.

The 'Causer Pays' Procedure determines contribution factors to allocate Regulating FCAS costs to those Market Generators, Market Customers and Small Generation Aggregators with facilities that have the metering capable of determining their contribution to frequency deviations at any time.

This Procedure assigns a single contribution factor to those Market Participants, which represents their aggregate contribution to the need for Regulating FCAS on a portfolio basis across the NEM. The causer pays contribution factors are calculated every four weeks based on historical data. This contribution factor is not dependent on the amount of energy purchased/consumed by the Market 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 generation it is contributing. Any Market Generator with a non-zero contribution factor who has generating units in SA will incur Regulating FCAS costs.

The residual costs (those not recovered through the application of the individual Market Participant factors) are recovered from Market Customers (usually retailers) in the relevant region, based on the amount of energy each Market Customer is purchasing.

More information on the payments and recovery of ancillary services is published at: http://www.aemo.com.au/Electricity/Data/Ancillary-Services/Ancillary-Services-Payments-and-Recovery.

5.5.1 AEMO's settlements process issue

Given the magnitude of FCAS settlements resulting from the APPs, AEMO has been reviewing its calculations process to ensure all costs are allocated correctly.

Following this review, AEMO identified that its settlements systems can produce outcomes that are not compliant with the NER, specifically where FCAS costs are recovered from Market Participants on a regional basis.

The issue was caused by the way multiple Participant Identifiers were handled for the Regulating FCAS cost recovery process. This was not a factor in the high SA FCAS prices themselves, but it affected individual settlement outcomes because of the way the costs were initially allocated between Market Participants in SA.

[22] The Procedure is located at: http://www.aemo.com.au/Electricity/Market-Operations/Ancillary-Services/Process-Documentation/Ancillary-Services-Causer-Pays-Contribution-Factors.

This issue was communicated to the market via AEMO Communications on 6 and 18 November 2015. The issue and the solution were discussed at the NEM Wholesale Consultative Forum on 25 November 2015.

AEMO has implemented a solution to amend the settlement component of the Electricity Market Management System (EMMS) on 2 December 2015. The solution ensures that the recovery calculation correctly applies the individual Market Participant factors calculated in accordance with the 'Causer Pays' Procedure, consistent with the NER. The implementation date for the solution and the five billing weeks impacted by the change were communicated to the market via an AEMO Communication on 1 December 2015.

AEMO has worked with individual Market Participants affected by the issue to finalise the settlement revision amounts and timing.

AEMO proposes to consult on whether the 'Causer Pays' Procedure and, potentially, related NER requirements, remain appropriate.

6. CONCLUSIONS AND NEXT STEPS

6.1 Conclusions

During planned outages for each of the South-East Heywood 275kV transmission lines, AEMO invoked Regulating FCAS constraint sets (F-S_LREG_0035 and F-S_RREG_0035) to procure 35 MW of Raise and Lower Regulating FCAS in SA. This was to ensure the power system was secure pre-contingent given the credible risk of separation. The constraint equations in the constraint sets are in accordance with the Constraint Formulation Guidelines.

SA currently has a small number of FCAS providers, which has the potential to result in high FCAS prices every time SA is at risk of islanding or is islanded.

6.2 Improvements made or in progress

AEMO intends to continue to procure local Regulating FCAS in SA on a pre-contingent basis if SA is at risk of islanding. AEMO is currently reviewing the Regulating FCAS availability in other regions to determine whether it needs to apply the same process when if they are at risk of islanding. These processes will be monitored over time for their continued efficacy.

Two power stations that are currently capable of providing FCAS in SA have announced plans to fully or partially withdraw from the market by 2018[23]. This will have implications for FCAS prices unless new FCAS providers emerge in SA. AEMO has received enquiries from Generators wishing to classify their generating units in SA as ancillary service generating units following the high price events described in this report. One Generator has, in fact, completed this process and can now provide FCAS in SA.

AEMO has been addressing the settlements issue by implementing a system change and revising settlement statements where applicable.

6.3 Planned Improvements

In the future, AEMO will take steps to inform the market if AEMO decides to procure Regulating FCAS on a pre-contingent basis for other regions. AEMO is still determining the best method for doing this.

AEMO plans to conduct a review on the causer pays process and discuss preliminary findings with stakeholders in early 2016, before determining the scope of any further consultation.

As a result of the technical forum held on 7 December 2015, AEMO is currently considering items raised by participants, and will keep the market informed on further outcomes.

[23] Announcement from Alinta Energy for the closure of Northern Power Station by March 2018 (may close earlier but not before March 2016): https://alintaenergy.com.au/about-us/news/flinders-operations-announcement. Announcement from AGL to mothball Torrens Island Power Station A in 2017: https://www.agl.com.au/about-agl/media-centre/article-list/2014/december/agl-to-mothball-south-australian-generating-units.

APPENDIX A. FREQUENCY REGULATION IN SA

Whenever synchronous separation of SA from the remainder of the NEM is a credible contingency, the Heywood Interconnector flow is limited to 250MW, a value broadly aligned with the historical maximum contingency size within the SA power system. The reason for limiting the flow is to manage the impact of a separation on power system voltage and frequency in SA.

The UFLS scheme is set to trigger automatically following a large frequency deviation event, including an interconnector trip. UFLS arrests the fall in frequency following separation, thereby preventing the power system from collapsing.

Regulating FCAS must then be dispatched to manage variations in demand and generation levels in the islanded SA network, and to support a quick recovery of frequency to within the frequency operating standards.

Regulating FCAS works to bring frequency in the SA islanded region back within an acceptable range of the 50 Hz target. Where synchronous separation is a credible contingency, the purchase of local Regulating FCAS is designed to mitigate the real risk that the post-separation frequency in SA will vary materially at a time when AEMO's AGC does not have control over any generation with the capability to increase or decrease output over short timeframes.

Without the necessary frequency regulation, there is a risk that widespread load shedding and tripping of generation in SA would occur as a result of uncontrolled frequency variations.

Further information on this scenario is available in the AEMO / ElectraNet Renewable Energy Integration in SA Report 2014 (http://www.aemo.com.au/Electricity/Planning/Integrating-Renewable-Energy).

APPENDIX B. HIGH REGULATING FCAS PRICES

Figures 5 and 6 show Raise and Lower Regulating FCAS prices in SA during the outage period. The period displayed is from 11 October 2015 1045 hrs to 10 November 2015 1730 hrs. The non-outage periods are shaded in semi-transparent grey colour ( ).

During the outage period, the Regulating FCAS prices fluctuated while the amount of Regulating FCAS procured in SA remained constant (35 MW of Raise and 35 MW of Lower Regulating FCAS).

The Lower Regulating FCAS price first peaked at $7,536.61/MWh in DI 1200 hrs on 11 October 2015. The Lower Regulating FCAS price was above $13,000/MWh for a couple of DIs between 1400 hrs and 1600 hrs on 11 October 2015 (before Regulating FCAS providers in SA rebid capacity from low to high price bands).

The first rebid that shifted Regulating FCAS capacity from low to high price bands was submitted by Torrens Island at 1804 hrs for Raise Regulating FCAS, effective from TI 2330 hrs. This rebid was replaced by the rebid submitted by Torrens Island at 2018 hrs which shifted capacity from low to high price bands for Raise and Lower Regulating FCAS, effective from DI 2025 hrs.

Figure 5 Raise Regulating FCAS price in SA (price in logarithm scale)

Figure 6 Lower Relating FCAS prices in SA (price in logarithm scale)

APPENDIX C. REGULATION FCAS BID STACK

Figures 7 and 8 further analyse the bid stack charts provided in Figures 3 and 4. The period displayed in the charts is from 11 October 2015 1045 hrs to 10 November 2015 1730 hrs.

Figures 7 and 8 display bid stacks for the outage periods only, by greying out the non-outage periods.

Note the following.

- Grey shaded period ( ) : No outage for the South East - Heywood line.
- Semi-transparent pink shaded period ( ): APPs (triggered three times during the analysed period).
- Yellow circle ( ): The most relevant bids for the high pricing outcomes.

It can be seen that the first and the second APPs extended into the non-outage periods as it took a few days to reduce the 7-day cumulative price below the threshold. This is represented by the overlap between the grey and pink shades.

The Regulating FCAS requirement was 35MW during the outage. The red line depicts the total amount of Regulating FCAS enabled within SA. This line shows that the local Regulating FCAS enablement was at 35MW most of the time. There was a small number of times where the local enablement was higher than 35 MW. This occurred due to Regulating and Delayed Contingency FCAS co-optimisation. For example, in the late evening on 1 November 2015, Regulating FCAS was enabled for more than 35 MW following the SA separation. This higher enablement was to substitute for the increased Delayed Contingency FCAS requirement in SA.

For the periods circled in yellow, it can be seen that the red line (i.e. total enablement in SA) crosses the purple areas. (i.e. capacity offered at a price greater than $12,000/MWh). The pink shaded areas (APP) follows the yellow circles immediately. This shows when the capacity was shifted into high-priced bands, resulting high Regulating FCAS prices and consequently triggering the APP.

Figure 7 Raise Regulating bid stack adjusted by actual availability

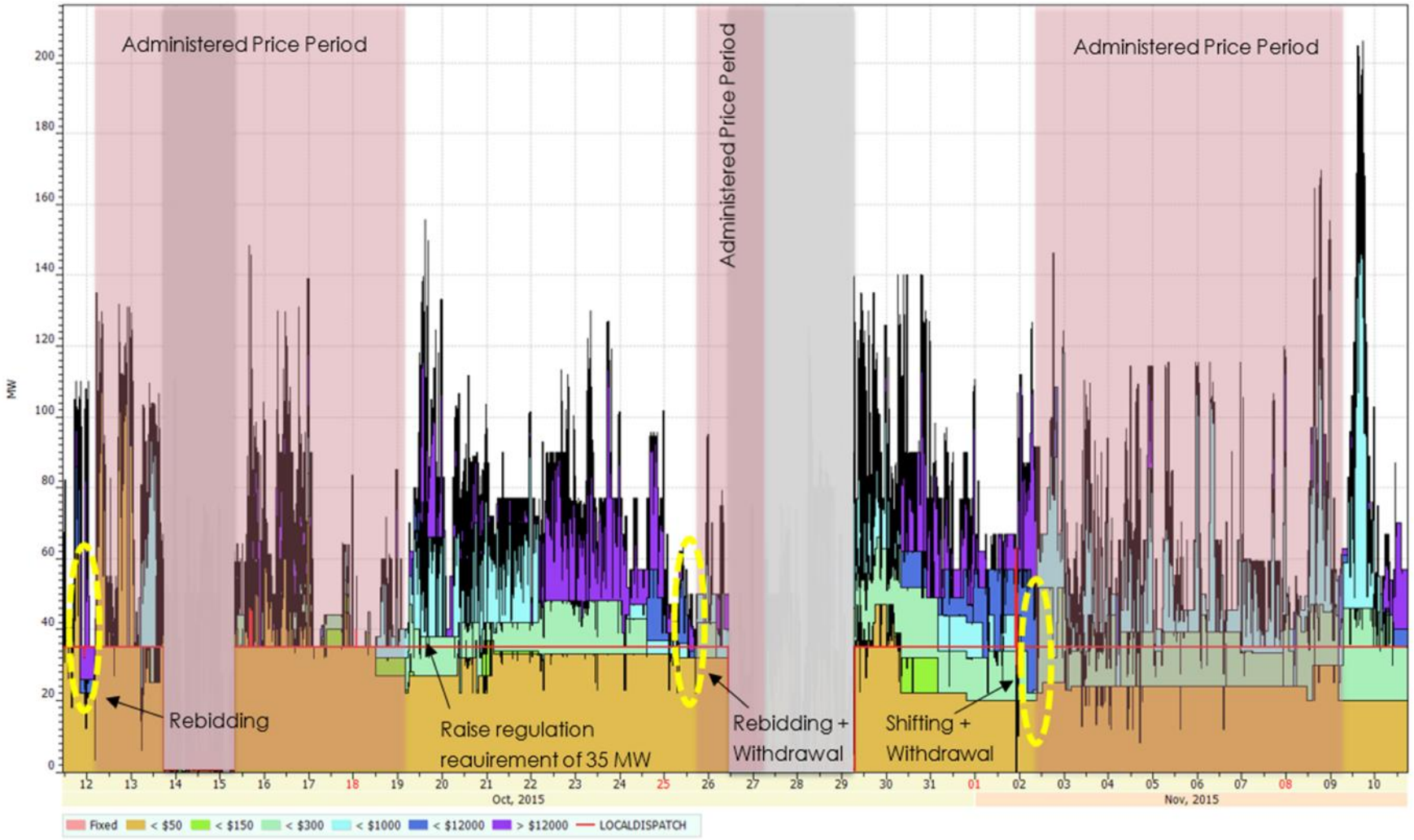
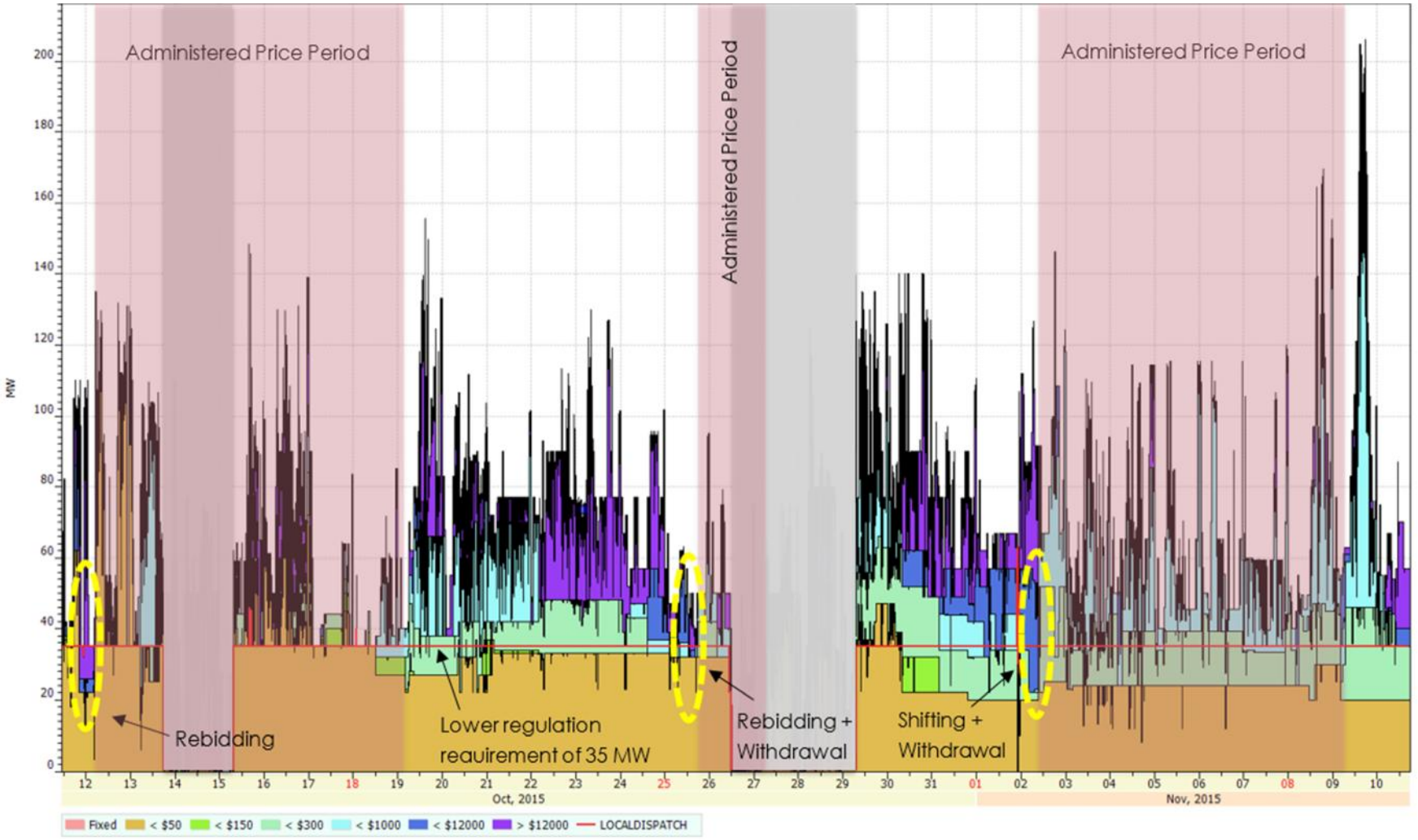


Figure 8 Lower Regulating bid stack adjusted by actual availability



ABBREVIATIONS AND DEFINITIONS

Term	Definition
AC	Alternating Current
AEMO	Australian Energy Market Operator
APC	Administered Price Cap
APP	Administered Price Period
CBs	Circuit Breakers
DC	Direct Current
DI	Dispatch Interval
FCAS	Frequency Control Ancillary Service
JSSC	Jurisdictional System Security Coordinator
NEM	National Electricity Market
NER	National Electricity Rule
SA	South Australia
TI	Trading Interval
UFLS	Under Frequency Load Shedding
VIC	Victoria