

# Spot prices greater than \$5000/MWh



AUSTRALIAN ENERGY  
REGULATOR

Queensland 4 November 2007

## Introduction

The AER is required to publish a report covering the circumstances in which the spot price exceeded \$5000/MWh, pursuant to clause 3.13.7 (d) of the Rules. That report should:

- describe significant factors contributing to the spot price exceeding \$5000/MWh, including withdrawal of generation capacity and network availability;
- assess whether rebidding pursuant to clause 3.8.22 contributed to the spot price exceeding \$5000/MWh;
- identify the marginal scheduled generating units; and
- identify all units with offers for the trading interval equal to or greater than \$5000/MWh and compare these dispatch offers to relevant dispatch offers in previous trading intervals.

This report examines the factors that can contribute to the spot price exceeding \$5000/MWh including; changes in demand (compared to that forecast by NEMMCO); generator offers and rebidding (including changes to generation capacity); and changes to network availability.

## Summary

On Sunday 4 November, the spot price in Queensland exceeded \$5000/MWh in two trading intervals, reaching \$5723/MWh at midday and \$6000/MWh at 12.30 pm. High prices continued over much of the rest of the day.

A planned network outage of the Tarong to Braemar line reduced available supplies in the region, constraining off generation in south west Queensland and forcing flows across the interconnector into New South Wales counter price. This outage, combined with constraints to manage the counter price flows, had significant impacts on supply to Queensland, resulting in forecast prices of \$100/MWh for the period around midday compared to around \$25/MWh in New South Wales.

Rebidding of capacity into higher prices by Stanwell, combined with an unplanned outage of CS Energy's Swanbank unit E, drove the price in Queensland to exceed \$5000/MWh.

More generally, from mid October there have been a number of similar network outages or reclassification events that have restricted transfer capability across QNI and output from south west Queensland generation. This congestion has arisen only recently with the addition of new capacity in the south west - 450 MW at Braemar last year and 750 MW at Kogan Creek since October.

The AER has identified a number of issues with the performance of generators during these events that have at times exacerbated the network congestion. The AER is looking closely at the compliance of generators with respect to following dispatch instructions<sup>1</sup>, the use of the inflexibility provisions and generator commissioning programs.

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<sup>1</sup> On 21 December 2006 the AER released a compliance bulletin clarifying its expectations of generator's obligations to follow dispatch instructions.

## Actual and forecast demand

On 4 November demand in Queensland was moderate, peaking at 6833 MW at 7 pm, 860 MW lower than Queensland's highest ever Sunday demand. For the hour around midday, when half hour prices exceeded \$5000/MWh, demand was close to that forecast and around 6300 MW.

Figure 1 compares the actual demand in Queensland with that forecast by NEMMCO four and twelve hours ahead of dispatch. A comparison of actual and forecast spot price is also included.

*Figure 1: Actual and forecast demand and spot price in Queensland*

<b>Sunday 12 midday</b>	<b>Actual</b>	<b>4 hr forecast</b>	<b>12 hr forecast</b>
Demand (MW)	6293	6248	6210
Spot Price (\$MWh)	5723	100	100

<b>Sunday 12.30 pm</b>	<b>Actual</b>	<b>4 hr forecast</b>	<b>12 hr forecast</b>
Demand (MW)	6326	6292	6257
Spot Price (\$MWh)	6000	100	100

## Changes to network availability

A planned outage of a Tarong to Braemar 275kV line between 5.25 am and 4.25 pm reduced the capability for flows into the Brisbane load centre from generation in south west Queensland (a total of around 2380 MW of available capacity) and from New South Wales across QNI (750 MW nominal capability). Notice of the planned outage was first provided to NEMMCO by Powerlink on 24 October.

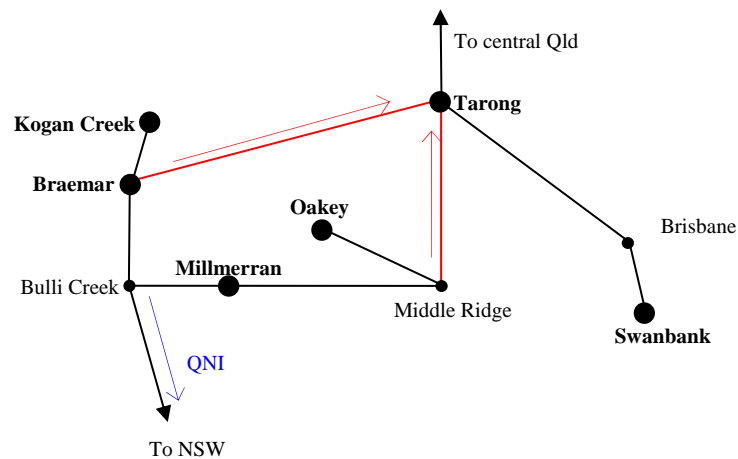
From 5.25 am, when the outage commenced, a constraint was invoked that saw QNI forced to flow into New South Wales at more than 900 MW.<sup>2</sup> These flows were counter to the prevailing market price.<sup>3</sup> At 5.45 am NEMMCO intervened with an additional constraint to reduce the counter price flows to 750 MW. Over a number of steps the flow was reduced further to around 400 MW from 11 am. Around \$5 million in negative settlement residues accrued across the interconnector over the period of the network outage.

Figure 2 shows a simplified diagram of the 330 kV and 275 kV network in south west Queensland. It highlights in red the lines which were operating at their maximum capabilities. It also shows the location of generation (large dots) and in blue the QNI interconnector. There were no constraints between central Queensland and the Brisbane load centre.

<sup>2</sup> The market forecasts signalled counter priced flows across the interconnector as a result of this outage. The output from the south west generators was not, however, significantly affected in those forecasts. The market systems were forecasting the dispatch of the lower priced south west generation counter priced into New South Wales in preference to the dispatch of higher priced generation in New South Wales.

<sup>3</sup> This was anticipated by NEMMCO the previous evening and advice was provided in a market notice at 5.17 pm on Saturday 3 November. In that notice, NEMMCO advised of forecast counter price flows on QNI on Sunday and stated that it would use reasonable endeavours to apply constraints to prevent the accumulation of negative residues provided system security could be maintained.

**Figure 2: Flow paths in south west Queensland**



The effect of the additional constraints that were invoked by NEMMCO to manage the negative residues was to constrain the south west generators below their forecast dispatch levels equivalent to the reduction in flows on QNI. Immediately before the outage, the Kogan Creek, Braemar and Millmerran generators were operating at a combined output of 1750 MW. Oakey power station, which is in the same area, was offline prior to the high priced period and was unable to be dispatched with this constraint binding. The additional constraints saw the combined output from these generators reduce from around 1750 MW prior to the outage to 1600 MW from 7.15 am, 1500 MW from 9.20 am and to less than 1400 MW between 10.05 am to 4.25 am.

By 1.30 pm, all of the south west generators that were online (Kogan Creek, Millmerran and Braemar) had submitted fixed load bids, preventing any further reductions in output. In total 1420 MW of generation in south west Queensland was offered as inflexible compared to the combined output before the outage of 1750 MW. The AER has sought further information from these participants about their use of the inflexibility provisions of the Rules.

Figure 3 compares the half hour average flow and limits for QNI for the 12 midday and 12.30 pm trading intervals with that forecast four and twelve hours ahead of dispatch.

Figure 4 shows the 5-minute flow and limits on QNI for the day. The period where the spot price was greater than \$5000/MWh is highlighted.

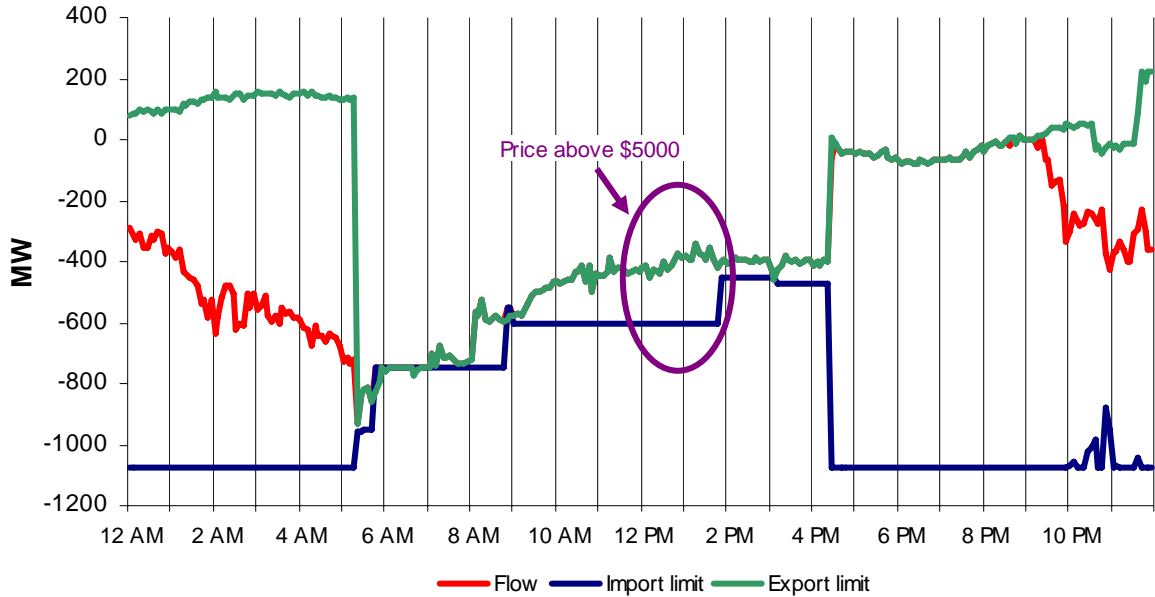
**Figure 3: Actual and forecast flow and limits across QNI (MW)**

<b>Sunday 12 midday</b>	<b>Actual</b>	<b>4 hr forecast</b>	<b>12 hr forecast</b>
Import limit	-600	-735	-880
Flows into Queensland	-430	-606	-880
Export limit	-430	-606	-880
Queensland price (\$/MWh)	5723	100	100
New South Wales price (\$/MWh)	25	25	25

<b>Sunday 12.30 pm</b>	<b>Actual</b>	<b>4 hr forecast</b>	<b>12 hr forecast</b>
Import limit	-600	-736	-879
Flows into Queensland	-430	-608	-879
Export limit	-430	-608	-879
Queensland price (\$/MWh)	6000	100	100
New South Wales price (\$/MWh)	25	25	25

**Figure 4: Combined 5-minute flow and limits across QNI into Queensland**



### Generator offers and rebidding

The network constraints reduced electricity flows from south west Queensland into Brisbane forcing the dispatch of more expensive capacity from central Queensland. Stanwell Corporation responded to the network constraints by rebidding 690 MW of capacity at Gladstone and Stanwell power stations (in central Queensland) from prices below \$300/MWh to prices above \$5000/MWh. The rebidding, combined with an unplanned outage of CS Energy’s Swanbank unit E, was the primary driver of the high prices around midday. Spot prices would have been around \$100/MWh in the absence of Stanwell’s rebidding.

The network outage resulted in forecast prices of \$100/MWh in Queensland and counter price flows into New South Wales where the price was forecast at \$25/MWh. Figure 5 compares the forecasts of south west Queensland generation and QNI flows south with actual outcomes. Twelve hours ahead, these generators had a forecast availability of 2300 MW, with 1810 MW priced below the forecast New South Wales price of \$25/MWh. Four hours ahead the impacts of NEMMCO’s constraints for negative settlement residue management saw these generators constrained down to 1600 MW. The actual dispatch of 1460 MW was affected by more restrictive constraints for negative settlement residue management. This reduction did not, however, affect the supply of energy from south west Queensland into Brisbane, which was forecast at around 1000 MW and was actually slightly higher than this in dispatch. The main impacts on price outcomes resulted from changes to generator offers in the remainder of the Queensland region.

**Figure 5: Actual and forecast dispatch in south west Queensland**

<b>Sunday 12 midday</b>	<b>Actual</b>	<b>4 hr forecast</b>	<b>12 hr forecast</b>
QNI	-430	-606	-880
South west Queensland generation	1,462	1,600	1,810
<b>Total</b>	<b>1,032</b>	<b>994</b>	<b>930</b>
Queensland price (\$/MWh)	5723	100	100
New South Wales price (\$/MWh)	25	25	25

<b>Sunday 12.30 pm</b>	<b>Actual</b>	<b>4 hr forecast</b>	<b>12 hr forecast</b>
QNI	-430	-608	-879
South west Queensland generation	1,459	1,600	1,810
<b>Total</b>	<b>1,029</b>	<b>992</b>	<b>931</b>
Queensland price (\$/MWh)	6000	100	100
New South Wales price (\$/MWh)	25	25	25

Figure 6 shows the actual generating capacity presented in Queensland for the trading intervals where the spot price was greater than \$5000/MWh. The figure compares this with the amount of available capacity forecast four and twelve hours ahead of dispatch. The change in the amount of capacity offered at prices less than the forecast price calculated four hours ahead of dispatch is also included and shows a significant reduction in capacity offered at less than the forecast price made four hours ahead.

**Figure 6: Actual and forecast capacity and spot price in Queensland**

<b>Sunday 12 midday</b>	<b>Actual</b>	<b>4 hr forecast</b>	<b>12 hr forecast</b>
Capacity (MW)			
Available	9388	9643	9816
priced at less than \$100	6607	7149	
Spot price (\$/MWh)	5723	100	

<b>Sunday 12.30 pm</b>	<b>Actual</b>	<b>4 hr forecast</b>	<b>12 hr forecast</b>
Capacity (MW)			
Available	8954	9643	9816
priced at less than \$100	6883	7149	
Spot price (\$/MWh)	6000	100	

At 9.15 am, Stanwell Corporation increased the availability of Barron Gorge unit 2 by 30 MW, 20 MW of which was priced at zero. The rebid reason given was “Fuel management::change avail/MW distrib”. Over several rebids from 9.17 am, Stanwell Corporation shifted as much as 310 MW of capacity at Gladstone and Stanwell from prices of less than \$100/MWh to above \$9000/MWh and a further 330 MW from prices of between \$100/MWh and \$300/MWh to above \$9000/MWh. The reasons given were “Manage transmission constraint::change MW distrib”, “Material change in market conditions::change MW distrib” and “Portfolio optimisation::change MW distrib”. A further rebid at 11.37 am shifted an additional 50 MW from prices of less than zero to above \$9000/MWh at Gladstone unit 6. By this time 170 MW or 60 per cent of the capacity of Gladstone unit 6 output was priced above \$9000/MWh where 260 MW or over 90 per cent had originally been priced at less than \$250/MWh. This rebid was first used in the dispatch interval ending

11.45 am when the price increased from \$105/MWh – which was close to forecast – to \$4145/MWh. This was followed by a further rebid that reduced the availability of Gladstone unit 6 by 175 MW. This unit shut down soon after. The rebid reasons given were “Mill limitations::change availability” and “Rebid to match plant output/avail::change avail”. At 12.02 pm effective at 12.10 pm, Mackay gas turbine increased its availability from zero to 34 MW. All of this capacity was priced at zero. The rebid reason given was “Material change in market conditions::change MW distrib”.

At 11.45 am effective from 11.55 am, Tarong Energy shifted 200 MW of capacity at Wivenhoe unit 2 from \$4100/MWh to around \$90/MWh. At the same time, 100 MW of capacity was shifted from prices of less than \$500/MWh to above \$5000/MWh at Tarong. The rebid reasons given were “Avoid Wivenhoe rough run band::Volume profile change”.

At 11.49 am, CS Energy’s Swanbank unit E tripped from full load of 348 MW. At the time, all of this capacity was priced below zero. The unit returned to service at around 10 pm.

The Stanwell, Tarong Energy, and CS Energy rebidding was related to generating stations that were not directly affected by the network congestion in south west Queensland.

The generators involved in setting the spot price during the 12 midday and 12.30 pm trading intervals, and how that price was determined by the market systems are detailed in **Appendix A**.

The closing bids for all participants in Queensland with capacity priced at or above \$5000/MWh during this period are presented in **Appendix B**.

### **Assessment**

On Sunday 4 November a planned network outage of a Tarong to Braemar 275 kV line restricted power flows from south west Queensland into Brisbane and caused significant counter priced flows to occur across QNI into New South Wales. The network outage had the effect of reducing the availability of low priced capacity to Brisbane. This reduction in supply was forecast to cause prices to increase from around \$25/MWh to \$100/MWh.

Between 9.17 am and 11.37 am Stanwell Corporation rebid a total of 690 MW of capacity from prices below \$300/MWh to above \$5000/MWh. 360 MW of this capacity was originally priced below \$100/MWh. At around midday an unplanned outage of CS Energy’s Swanbank unit E occurred, reducing the availability of low priced capacity by a further 350 MW. In combination these events drove the spot price above \$5000/MWh.

To reduce the counter price flows NEMMCO invoked additional network constraints which further restricted the dispatch of generation in south west Queensland but did not materially affect price outcomes in Queensland.

The AER has identified a number of issues with the performance of generators during this and other similar events during October and November that have at times exacerbated network congestion. The AER is undertaking a review of the compliance of generators with respect to following dispatch instructions, the use of the inflexibility provisions and generator commissioning programs.

**Australian Energy Regulator**

**December 2007**

## Appendix A – Price setters for the 4 pm trading interval

The following table identifies the trading intervals in which the spot price exceeded \$5000/MWh. Each five minute dispatch interval price and the generating units involved in setting the energy price, as published in the market systems are shown. This information is published by NEMMCO<sup>4</sup>. Also shown is the energy or ancillary service offer price involved in determining the dispatch price together with the quantity of that service and the contribution to the total energy price. The 30-minute spot price is the time weighted average of the six dispatch interval prices.

### Sunday 4 November - Queensland - 12 midday

Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contribution
11.35	\$101.00	Origin Energy	MSTUART1	Energy	\$101.00	1.00	\$101.00
11.40	\$105.62	Hydro Tasmania	JBUTTERS	Raise 5 min	\$4.90	0.62	\$3.02
		Hydro Tasmania	JBUTTERS	Raise 60 sec	\$0.94	0.40	\$0.38
		Delta Electricity	MP1	Energy	\$25.00	0.41	\$10.31
		Delta Electricity	MP1	Raise 5 min	\$1.00	-0.03	-\$0.03
		Delta Electricity	MP1	Raise 60 sec	\$0.10	-0.03	\$0.00
		Delta Electricity	MP1	Raise 6 sec	\$0.50	-0.04	-\$0.02
		CS Energy	SWAN_B_1	Energy	\$100.52	1.00	\$100.52
		CS Energy	SWAN_B_1	Raise 5 min	\$1.00	-1.00	-\$1.00
		CS Energy	SWAN_B_1	Raise 60 sec	\$0.20	-0.38	-\$0.08
		CS Energy	SWAN_B_1	Raise 6 sec	\$0.20	-0.38	-\$0.08
		Delta Electricity	VP6	Energy	\$20.00	-0.41	-\$8.25
		Delta Electricity	VP6	Raise 5 min	\$1.00	0.41	\$0.41
		Delta Electricity	VP6	Raise 6 sec	\$1.03	0.41	\$0.42
11.45	\$4145.60	Tarong	W/HOE#2	Energy	\$4145.60	1.00	\$4145.60
11.50	\$9996.40	Stanwell	GSTONE1	Energy	\$9994.90	1.00	\$9994.90
		Stanwell	GSTONE1	Raise reg	\$0.49	-1.00	-\$0.49
		Stanwell	STAN-4	Raise reg	\$1.99	1.00	\$1.99
11.55	\$9994.90	Stanwell	GSTONE1	Energy	\$9994.90	0.25	\$2498.73
		Stanwell	GSTONE3	Energy	\$9994.90	0.25	\$2498.73
		Stanwell	GSTONE4	Energy	\$9994.90	0.25	\$2498.73
		Stanwell	GSTONE5	Energy	\$9994.90	0.25	\$2498.73
12.00	\$9994.90	Stanwell	GSTONE3	Energy	\$9994.90	0.50	\$4997.45
		Stanwell	GSTONE5	Energy	\$9994.90	0.50	\$4997.45
<b>Spot price</b>		<b>\$5723.07/MWh</b>					

### Sunday 4 November - Queensland - 12.30 pm

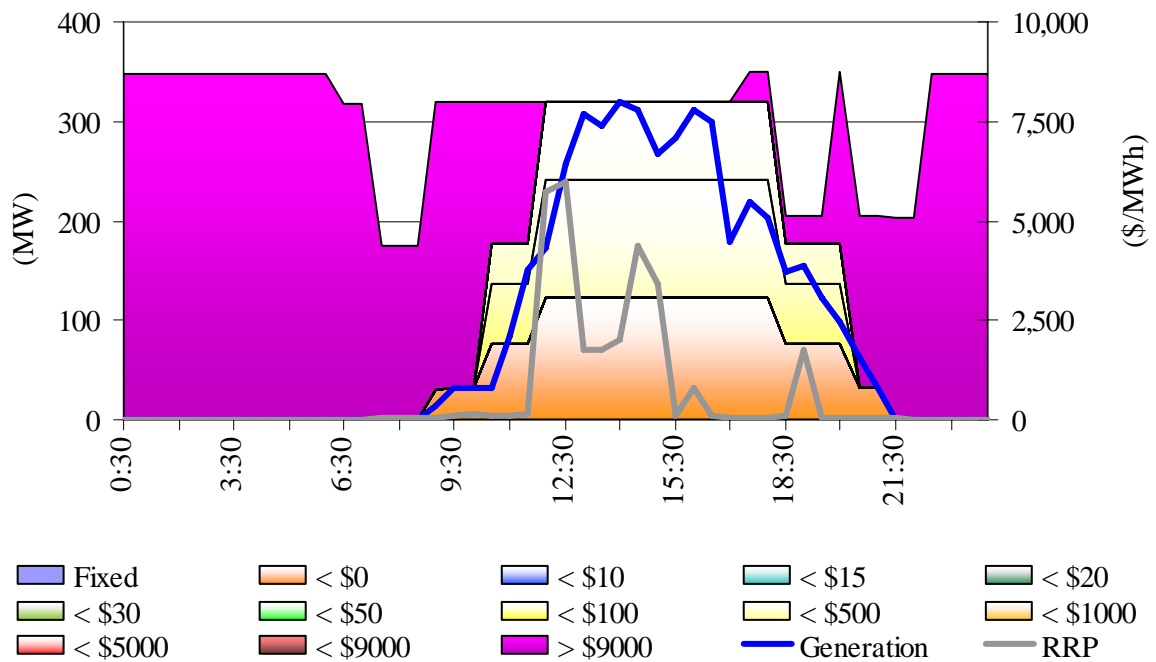
Time	Dispatch price	Participant	Unit	Service	Offer price	Marginal change	Contribution
12.05	\$9993.19	Stanwell	GSTONE1	Energy	\$9994.90	1.00	\$9994.90
		Stanwell	GSTONE1	Lower reg	\$0.99	1.00	\$0.99
		Delta Electricity	MP1	Lower reg	\$2.70	-1.00	-\$2.70
12.10	\$119.14	CS Energy	SWAN_B_2	Lower reg	\$3.85	-1.00	-\$3.85
		Tarong	TARONG#3	Energy	\$122.99	1.00	\$122.99
		Tarong	TARONG#3	Lower reg	\$0.00	1.00	\$0.00
12.15	\$9994.90	Stanwell	GSTONE3	Energy	\$9994.90	0.33	\$3331.60
		Stanwell	GSTONE4	Energy	\$9994.90	0.33	\$3331.60
		Stanwell	GSTONE4	Lower reg	\$1.95	0.33	\$0.65
		Stanwell	GSTONE5	Energy	\$9994.90	0.33	\$3331.60
		Stanwell	STAN-1	Lower reg	\$1.95	-0.33	-\$0.65
12.20	\$9994.90	Stanwell	GSTONE1	Energy	\$9994.90	0.33	\$3331.60
		Stanwell	GSTONE3	Energy	\$9994.90	0.33	\$3331.60
		Stanwell	GSTONE5	Energy	\$9994.90	0.33	\$3331.60
12.25	\$5800.00	Tarong	TARONG#2	Energy	\$5800.00	1.00	\$5800.00
12.30	\$101.00	Origin Energy	MSTUART1	Energy	\$101.00	1.00	\$101.00
<b>Spot price</b>		<b>\$6000.52/MWh</b>					

<sup>4</sup> NEMMCO first published details on how the price is determined, for every dispatch interval, in June 2004. Documentation of this process can be found at <http://www.nemmco.com.au/dispatchandpricing/140-0036.htm>

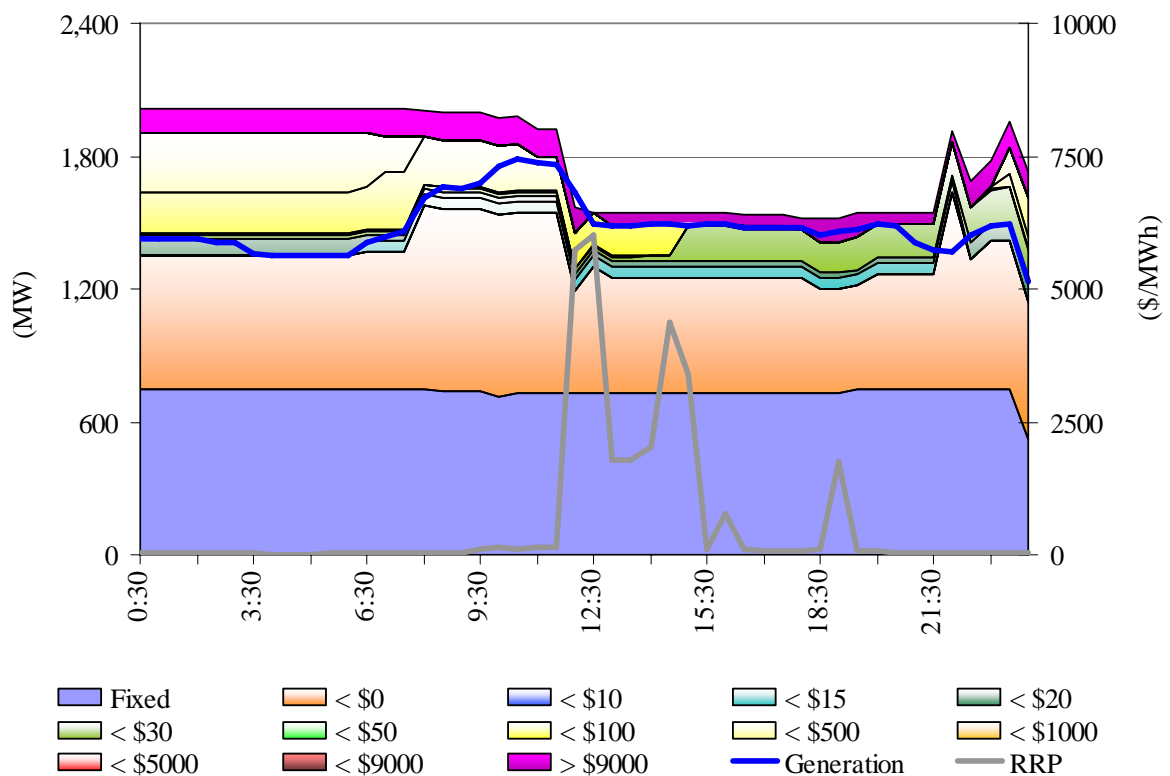
## Appendix B – Closing bids

Figures B1 to B6 highlight the half hour closing bids for all participants in Queensland with capacity priced at or above \$5000/MWh during the trading intervals in which the spot price exceeded \$5000/MWh. It also shows the generation output of that participant and the spot price.

**Figure B1: Origin Energy closing bid prices, dispatch and spot price.**

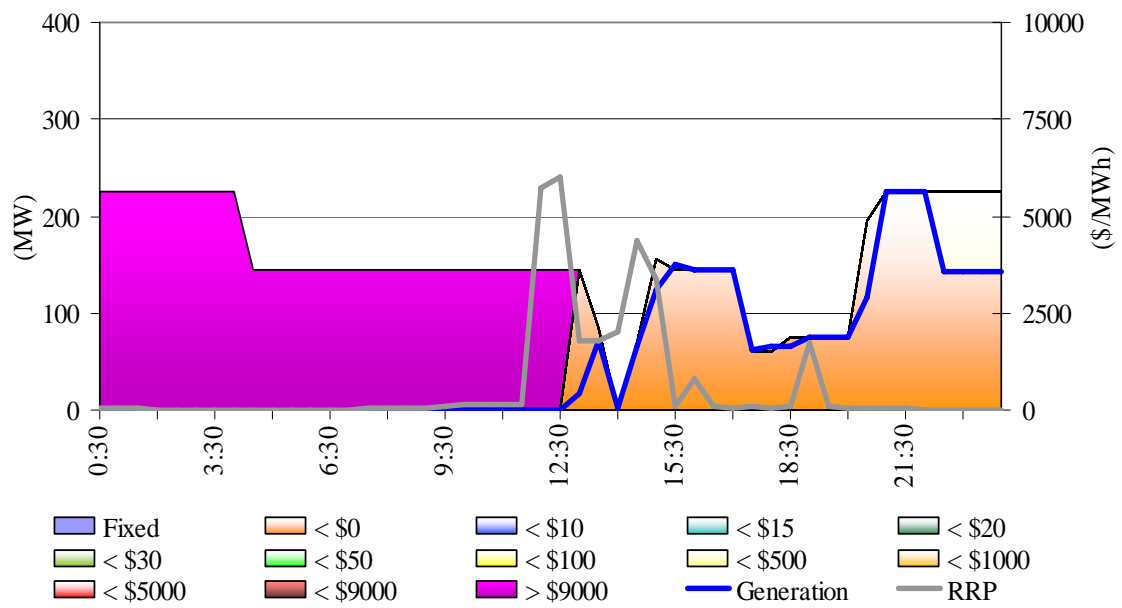


**Figure B2: CS Energy closing bid prices, dispatch and spot price.**

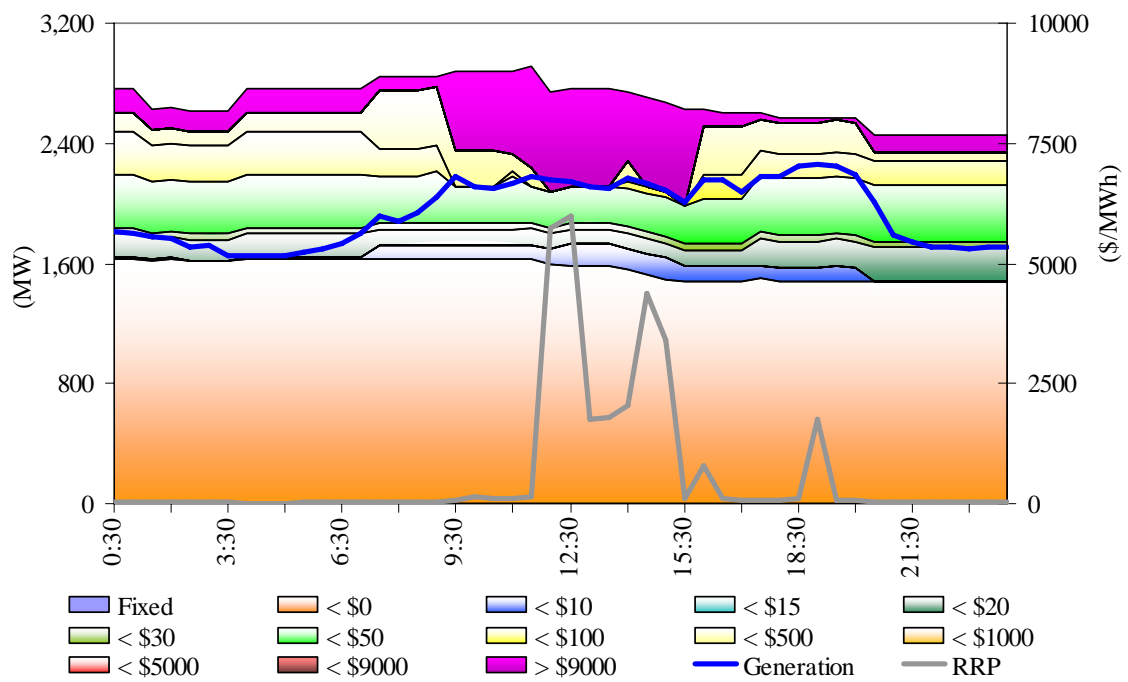




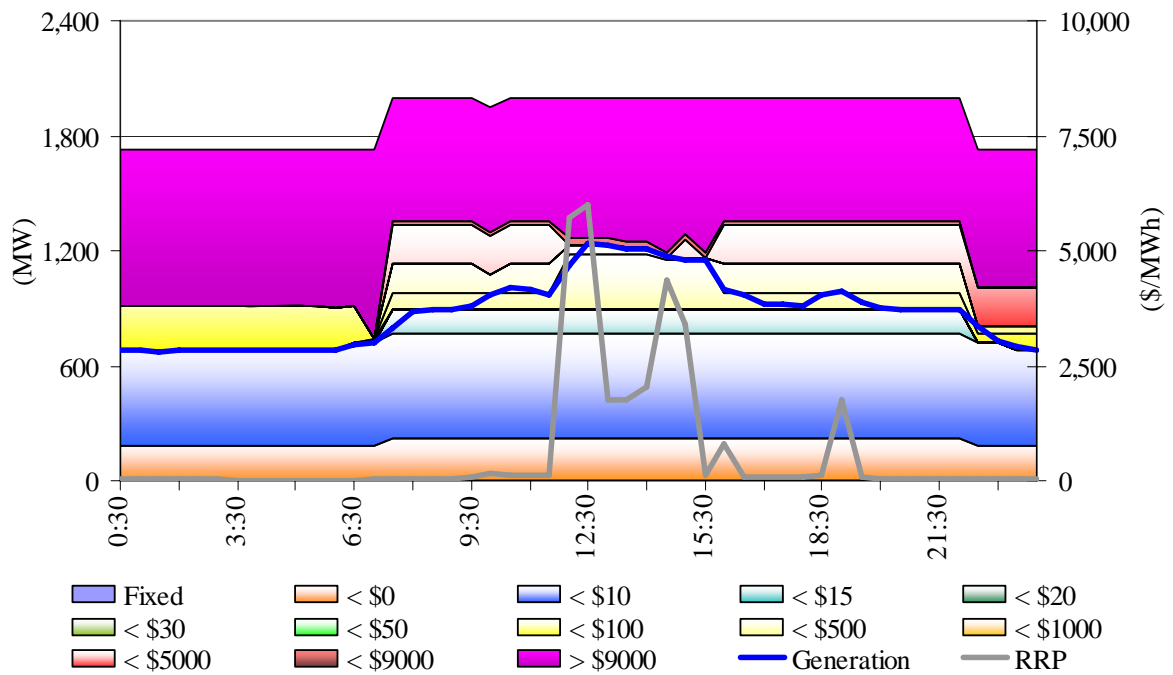
**Figure B3: Enertrade closing bid prices, dispatch and spot price.**



**Figure B4: Stanwell Corporation closing bid prices, dispatch and spot price.**



**Figure B5: Tarong Energy closing bid prices, dispatch and spot price.**



**Figure B6: Braemar closing bid prices, dispatch and spot price.**

