ELECTRICITY MARKET EVENT REPORT
NEM Operations Review – Queensland Summer 2012 (855/871 Congestion)

PREPARED BY: Electricity Market Performance

DATE: 31 May 2012

FINAL

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Abbreviations and Symbols

Abbreviation	Term
AEMC	Australian Energy Market Commission
DFS	Demand Forecasting System
DI	Dispatch Interval
NEM	National Electricity Market
QNI	Queensland - New South Wales 330 kV interconnector
SCADA	Supervisory Control and Data Acquisition
TNSP	Transmission Network Service Provider
TI	Trading Interval

Contents

1 Summary

From January 2012 to March 2012, a number of market pricing events occurred in Queensland.

Since January, the constraint equations that manage the post contingent flows on the Calvale – Stanwell No.855 and Calvale – Wurdong No.871 275 kV lines have increased in profile, due to the constraints binding frequently and causing large counter priced flows from Queensland to New South Wales.

This is most likely the result of participants attempting to manage their volume risk whenever the constraint binds as a result of changes to the dynamic ratings of the lines. More recently, legitimate generator bidding behaviour is influencing spot price volatility around the time of network constraints.

AEMO considers that network congestion issues will continue to arise, but the events of summer 2012 demonstrate that their market impact is as much an outcome of the electricity market design as network limits or participant behaviours. AEMO recommends the review be noted in the context of the Australian Energy Market Commission's (AEMC's) transmission frameworks review.

2 Background

During summer 2012, AEMO published a number of electricity pricing event reports[1] to explain the unusual market outcomes and the circumstances that led to high or negative prices in Queensland. Substantial inter regional negative residues accumulated on the Queensland to New South Wales interconnectors during these pricing events.

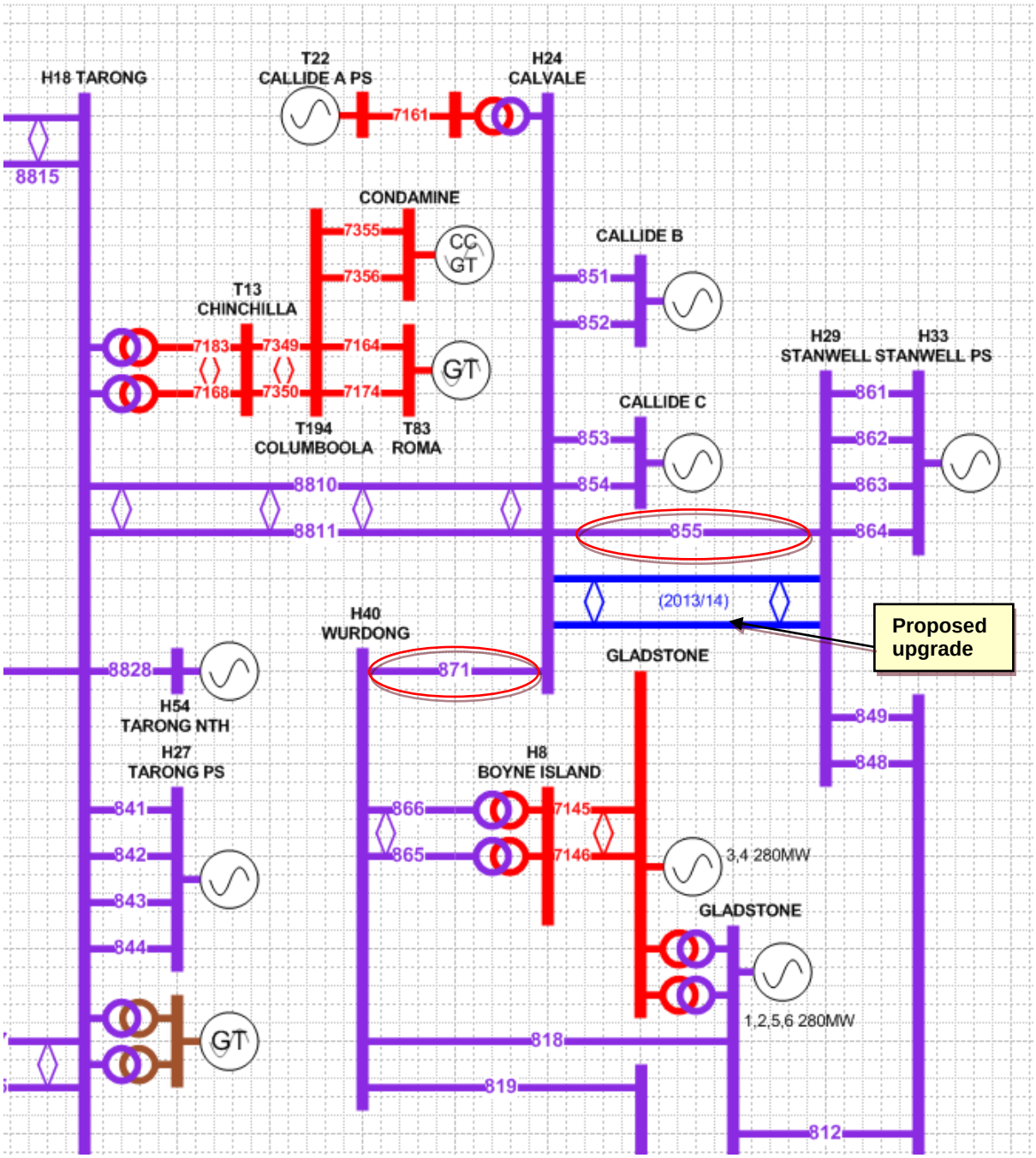
High energy prices in Queensland are usually associated with periods of high temperatures resulting in high demands. However, during the first quarter of 2012 pricing events were generally the result of network constraints and bidding in Queensland.

These pricing outcomes and counter price interconnector flows between Queensland and New South Wales were related to congestion issues on the 275 kV network between southern and central Queensland, specifically on the 855 and 871 lines. These lines connect the Callide power stations to the Stanwell and Gladstone power stations[2] (see Figure 1).

[1] AEMO publishes Electricity Pricing Event reports when regional energy prices exceed $300 per MWh, or are less than -$30 per MWh per Trading Interval. Reports can be viewed at http://www.aemo.com.au/reports/nemreports.html#pricing

[2] Last year, the Queensland government restructure its ownership of its generating assets. In this restructure, Gladstone Power Station was transferred from Stanwell to CS Energy (which also owned Callide) and Tarong Power Station (near Brisbane) was transferred to Stanwell Corporation.

Figure 1: Central Queensland Transmission Network



Powerlink has commenced the construction of the Calvale to Stanwell 275 kV line augmentation, which will increase the supply capability between Central West Queensland and North Queensland. The proposed commissioning date of this additional 275 kV line is summer 2013/14, as stated in Powerlink's Annual Planning Report 2011.

For more information regarding this augmentation refer to:

http://www.powerlink.com.au/Projects/Central/Calvale_to_Stanwell.aspx

3 Scope of this Review

This review covers the period 1 January 2012 to 31 March 2012 (summer 2012).

During this period constraint equations Q>>NIL_855_871 and Q>>NIL_871_855 bound frequently and contributed to the volatility of the Queensland 5-minute prices.

In this report AEMO reviews the outcomes of and the main contributors to the pricing events over summer 2012, including:

- Congestion management of 855 and 871 lines, covering dynamic line ratings and constraint action.
- Market outcomes, covering market prices, disorderly bidding, inter-regional settlements residue and pre-dispatch performance.

4 Congestion Management of 855 and 871 Lines

4.1 Dynamic Line Ratings

On 4 February 2010, on advice from Powerlink, AEMO started using dynamic ratings for a number of transmission lines in Queensland, including the 855 and 871 lines. The dynamic line ratings feed into the constraint equations Q>>NIL_855_871 and Q>>NIL_871_855, that manage the post contingent overload of the 871 and 855 lines respectively.

Dynamic ratings use a model of conductor temperature based on weather measurements and recent loading of the transmission line. Before this change, AEMO would receive the line ratings from Powerlink and would transcribe this information into AEMO's SCADA[3] for use in the relevant constraint equations.

The change to dynamic ratings has generally increased the rating from around 800 MVA to in excess of 900 MVA; however during hot periods with low wind, the thermal ratings may reduce substantially and quickly. Powerlink have limited the change in the line rating to 10 MVA per minute.

Descriptions of these constraint equations are given in the Appendix.

4.2 Constraint Action

The formulations of the two constraint equations and the effect the constraints have on Queensland generation and power flows are similar. When they bind, power is flowing from Calvale towards Stanwell and Gladstone (see Figure 2). Loss of either 275 kV line can result in the overload of the other line.

When binding, the constraint generally will act to reduce flow from Calvale toward Gladstone and Stanwell by, in order of preference[4] :

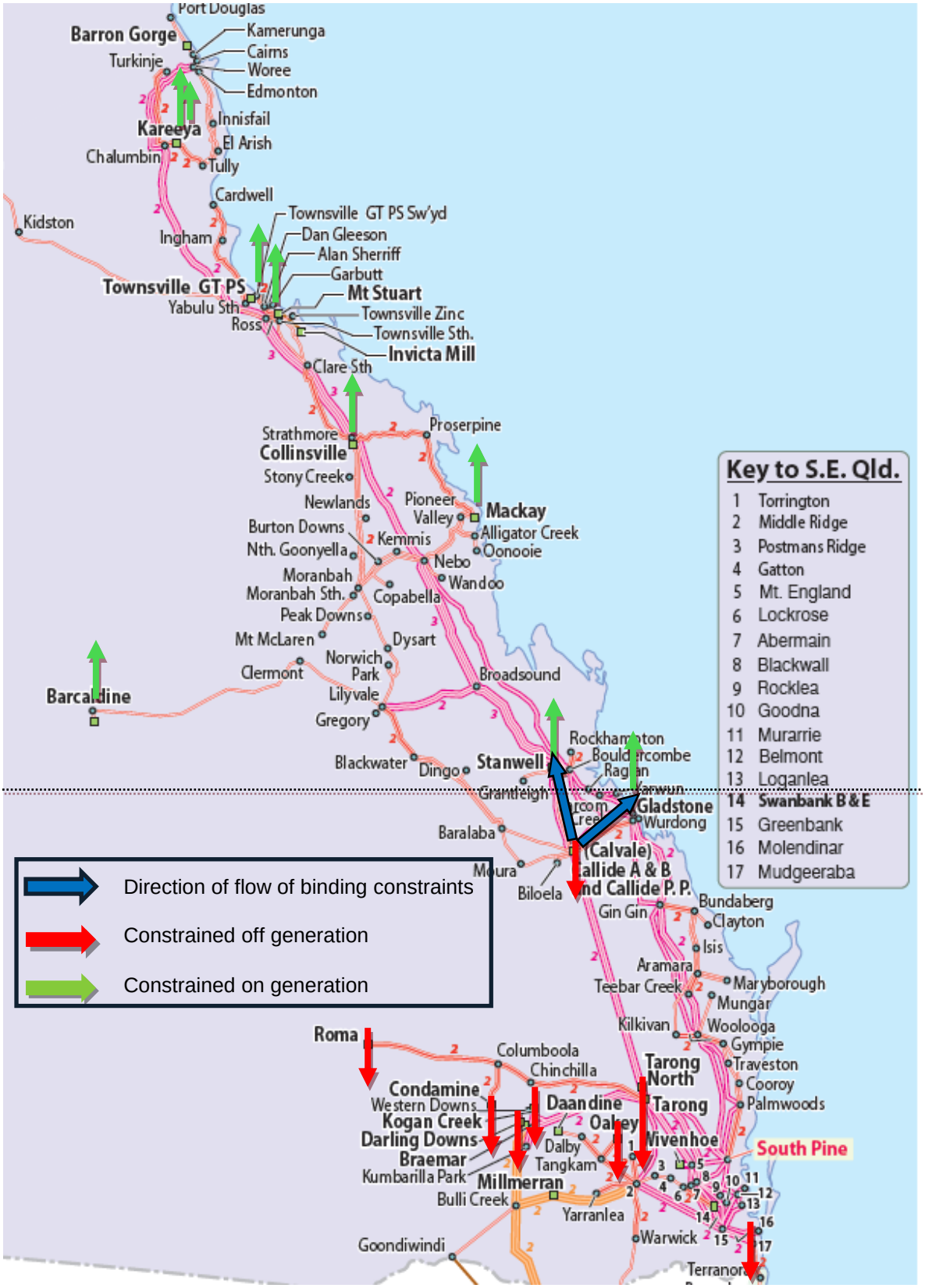
1. Constraining off Callide generation
2. Constraining on Gladstone generation
3. Constraining on Stanwell generation
4. Constraining on other north Queensland generation
5. Constraining off south Queensland generation or forcing flow from Queensland to New South Wales.

[3] Supervisory Control and Data Acquisition – a computer based system for monitoring the condition of the power system.

[4] Assuming factors such as bid and offer prices and ramp rates are similar and there is sufficient available capacity.

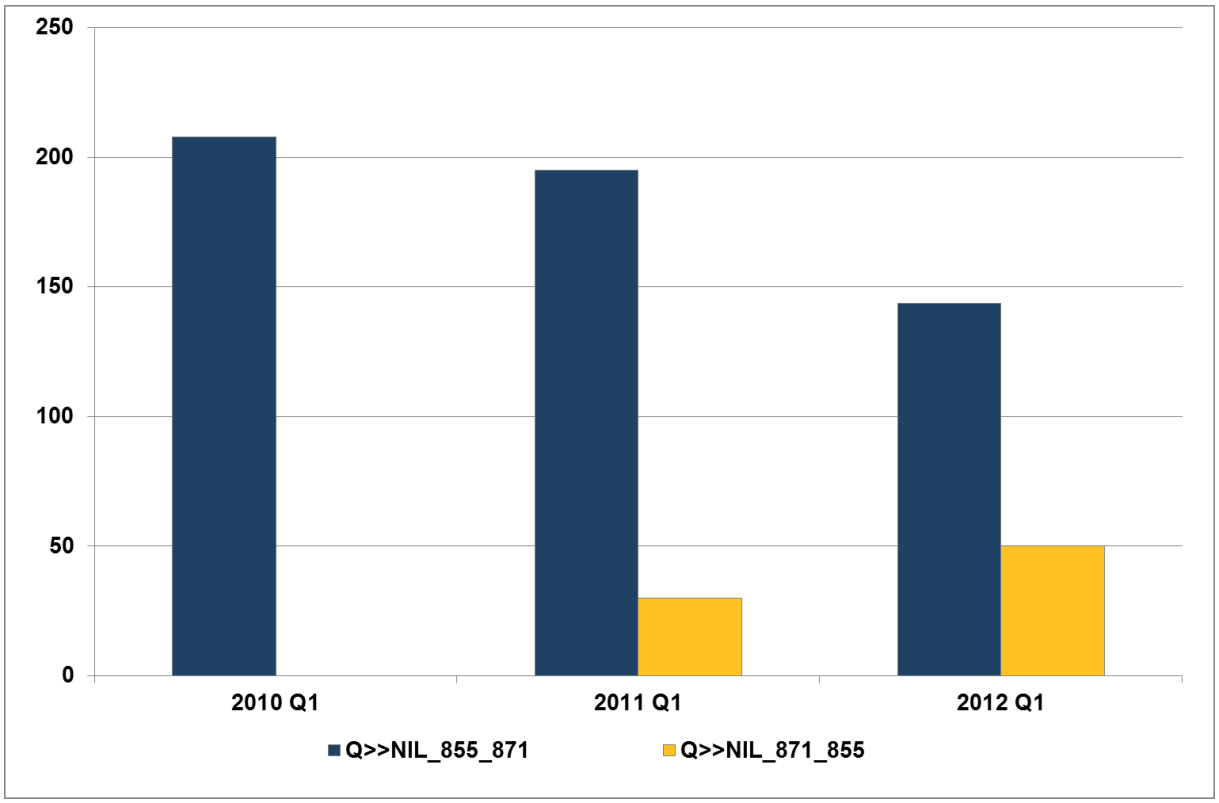
These effects are shown in Figure 2. Forcing flow from Queensland to New South Wales will generally increase the price in Queensland and reducing the price in New South Wales, resulting in a counter-price flow.

Figure 2: Queensland Transmission Network



The Q>>NIL_855_871 and Q>>NIL_871_855 constraint equations bound for approximately 144 hours and 50 hours respectively during the period under review (see Figure 3).

Figure 3: History of Binding Hours for Q>>NIL_855_871 and Q>>NIL_871_855 – Summer 2010 to 2012



The analysis in this report will focus on constraint equation Q>>NIL_855_871, since it was binding significantly more often than Q>>NIL_871_855 during summer 2012, and also contributed to almost all of the pricing events for Queensland.

4.3 Constraint Formulation

The constraint equations managing congestion on the 855 and 871 lines are formulated according to AEMO's constraint formulation guidelines[5]. In particular[6]:

- All coefficients in the equation were normalised by multiplying both left and right hand sides so the absolute value of the largest left hand side coefficient is 1.
- Any remaining left hand side terms with coefficients less than 0.07 were moved onto the right hand side.
- The constraints were formulated as feedback constraint equations.

Section 4.2 above describes the order of preference for the two constraints. In both equations, the interconnector coefficient is small but not below the 0.07 threshold (0.1246 for Q>>NIL_855_871 and 0.08076 for Q>>NIL_871_855).

[5] AEMO. "Constraint formulation Guidelines". Version 10. June 2010. Available http://www.aemo.com.au/en/Electricity/Market-and-Power-Systems/Dispatch/Constraint-Formulation-Guidelines . Viewed 24 May 2012.
[6] Ibid. See sections 5.5.1 and 7.2.

5 Market Outcomes

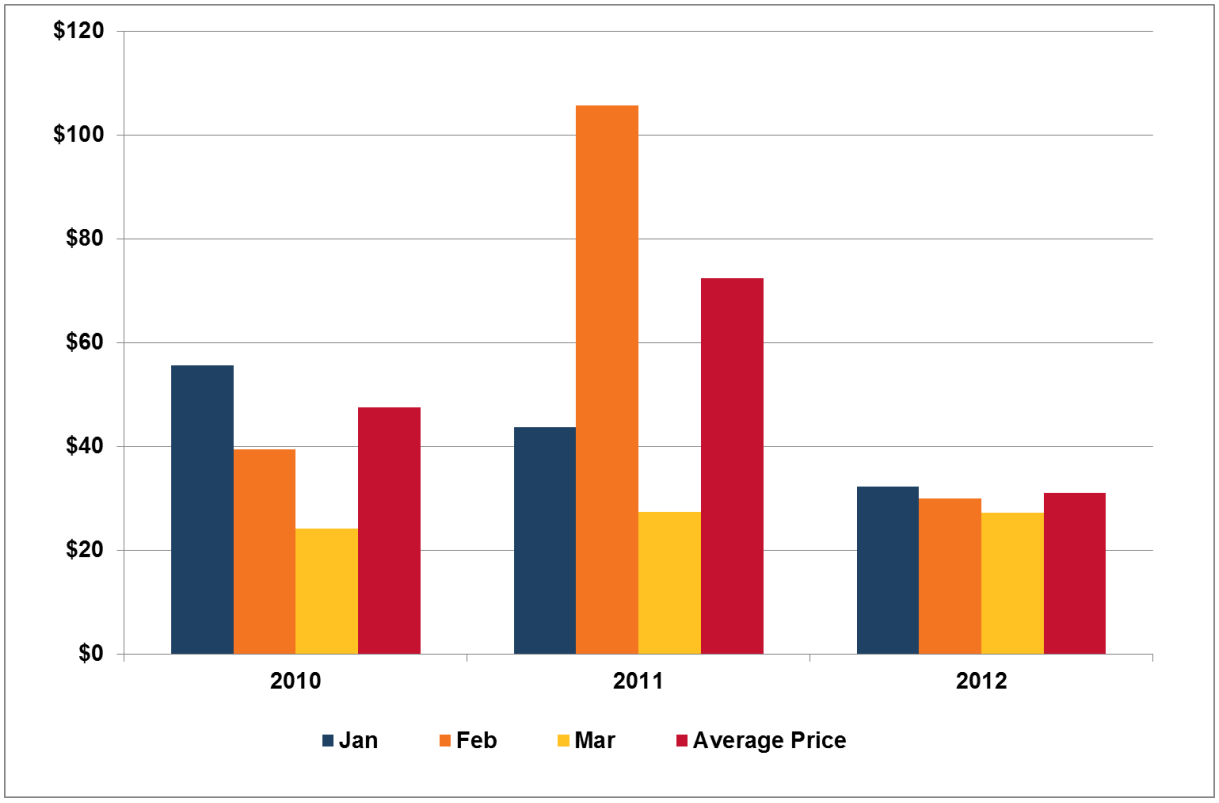
5.1 Market Prices

The average Queensland energy price during summer 2012 was $31.09 per MWh, significantly lower than previous years (see Figure 4). Although the average summer 2012 price was relatively low, Queensland experienced significant price volatility between trading intervals (TIs) (see Figure 5).

AEMO reports on pricing events when the 30-minute spot price is above $300 per MWh (see Figure 5) or below -$30 MWh. There were 17 pricing events reported for Queensland in summer 2012, compared to 10 events in Queensland in summer 2011 (including three associated with floods).

Six of the 17 pricing events in summer 2012 were directly caused by a substantial change in the dynamic ratings of 855 and 871 lines, compared to one pricing event in summer 2011 (see for example Figure 6).

Figure 4: Average Queensland Prices Summer 2010 to 2012 [7]



[7] Energy prices were higher in 2011 due to the Queensland floods

Figure 5: Queensland 30 Minute Prices Summer 2012

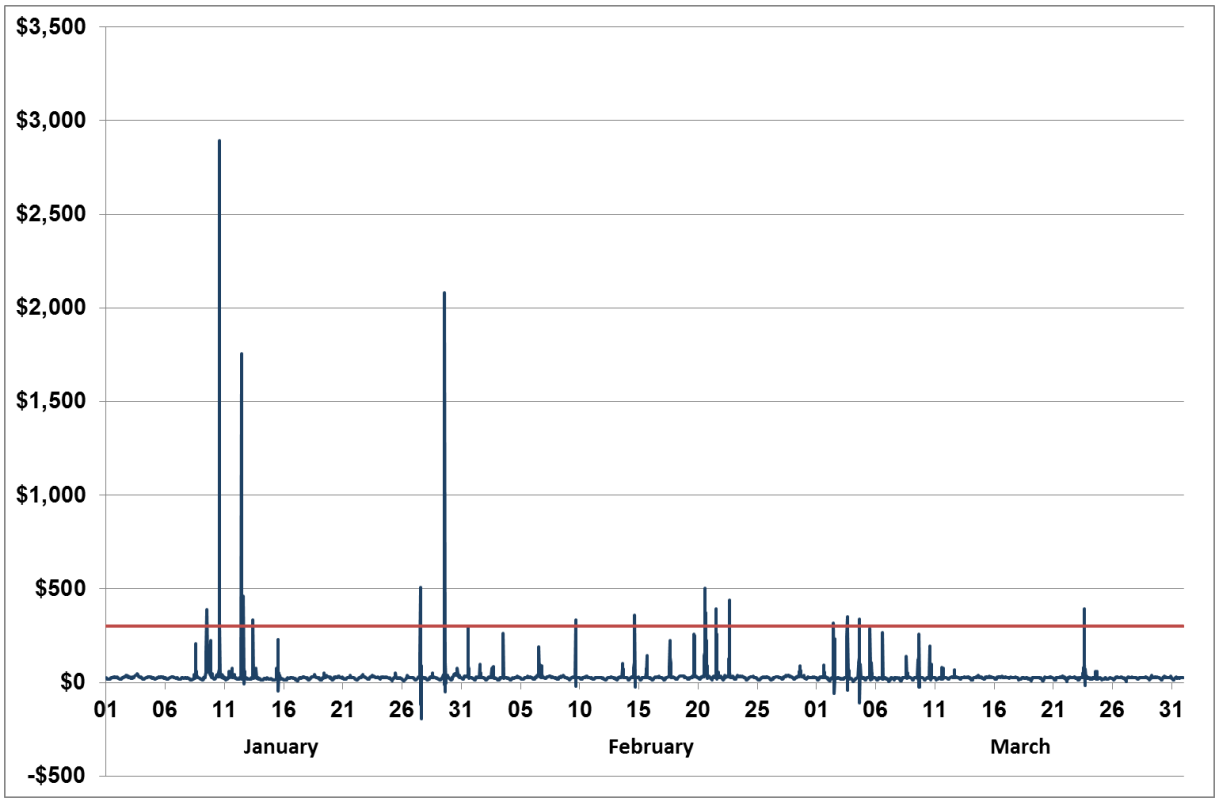
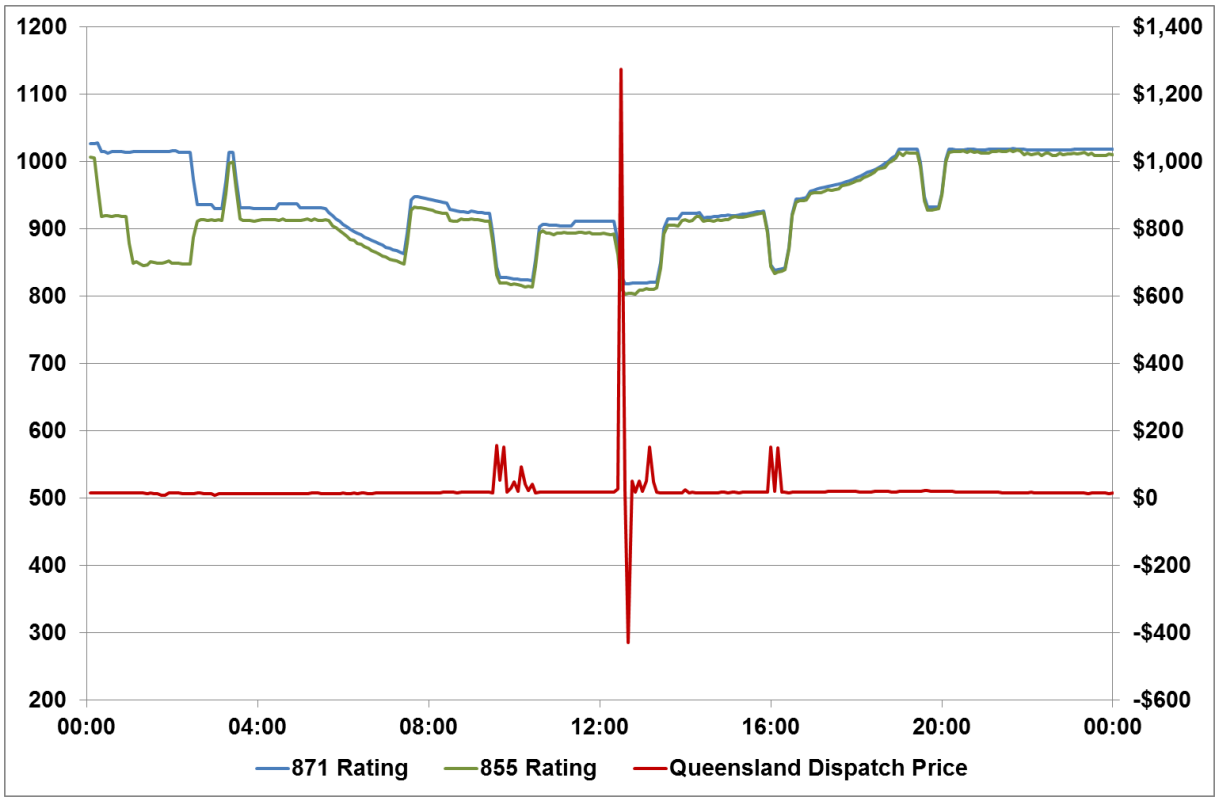


Figure 6: Impact of Dynamic Ratings on Queensland Prices – 15 January 2012



5.2 Bidding Response

As mentioned above, six of the 17 pricing events in Queensland in summer 2012 were related to dynamic rating changes. The remaining eleven events were related to “disorderly bidding”.

The AEMC describes disorderly bidding as behaviour by generators to reduce the extent of being constrained off. [8] It occurs because generators located behind constraints know that the price they receive will be set by higher-cost generation elsewhere and therefore can make non-cost reflective offers. Such generators will instead offer capacity at a price which maximises their dispatch.

This is both legitimate and rational under the current market design, where generators are exposed to dispatch risks from network congestion that can’t be managed by the participants.

Figures 7a and 7b illustrate a price event on 13 January 2012 caused by a bidding response. Although 855 and 871 line constraints were binding at the time, AEMO considers this to be unrelated to changes to its dynamic ratings.

Figure 7a shows the ratings and line flows on 855 and 871 lines during periods when the constraint was binding on 13 January 2012. The 871 post contingency flow was estimated by adding 65% of the flow on 855 line to the flow on 871 flow. Figure 7b shows the Gladstone bid profile in response to being constrained on and the Queensland five-minute price for the same period.

The Q>>NIL_855_871 was binding for most DIs between 0730 and 1600 hrs. From 0700 hrs, Callide Power Station was rebid to negative prices and was dispatched to full capacity. At 0925 hrs, a rebid for Gladstone Power Station moved 440 MW from price bands below $100 per MWh to price bands above $10,000 per MWh. With Callide at low prices and Gladstone at high prices, the next preferred units to be constrained (on) were at Stanwell. These units were ramp rate limited and the Queensland price was set by higher priced plant to around $1,400 per MWh.

The same behaviour occurred at 1426 hrs and 1526 hrs.

The next five-minute price was each time much lower due to a combination of ramp rate-limited plant being able to replace the higher priced bands of Gladstone and reoffers of plant at negative prices in response to the initial high price spike.

5.3 Inter-Regional Settlement Residues

Inter-regional settlement residues accumulate when there is a flow of power from one region to another and there is a price difference between the regions. The price difference occurs either due to losses or, more significantly, when a constraint is binding that affects an interconnector. In some cases, a constraint may force power to flow from a higher priced region to a lower priced region so that the residue that accumulates is negative.

If the accumulation of negative residues over a period of counter-price flows is expected to exceed a value of $100,000, AEMO will take action to prevent the accumulation exceeding $100,000, provided system security can be maintained.

In summer 2012, there were 37 instances where AEMO managed the accumulation of negative residues on the QNI interconnector. Despite this, the accumulated negative residues reached a value of approximately $6.84 million on 23 March 2012. This compares with negative residues of $4.98 million in 2011 and $319,000 in 2010. This also compares with accumulated positive residues in summer 2012 on QNI of $3.22 million.

Figure 8 shows daily and accumulated positive and negative residues for summer 2012 for the QLD to NSW directional interconnector.

Under national electricity rule changes introduced in 2009, the Transmission Network Service Provider (TNSP) in the importing region (in this case, TransGrid in New South Wales) is responsible for funding the negative residues.

[8] Australian Energy Market Commission. *Transmission Frameworks Review First Interim Report,* p.33. http://www.aemc.gov.au/Market-Reviews/Open/transmission-frameworks-review.html. 17 November 2011.

Figure 7a: 13 January 2012 – 855/871 Dynamic Ratings and Line Flows

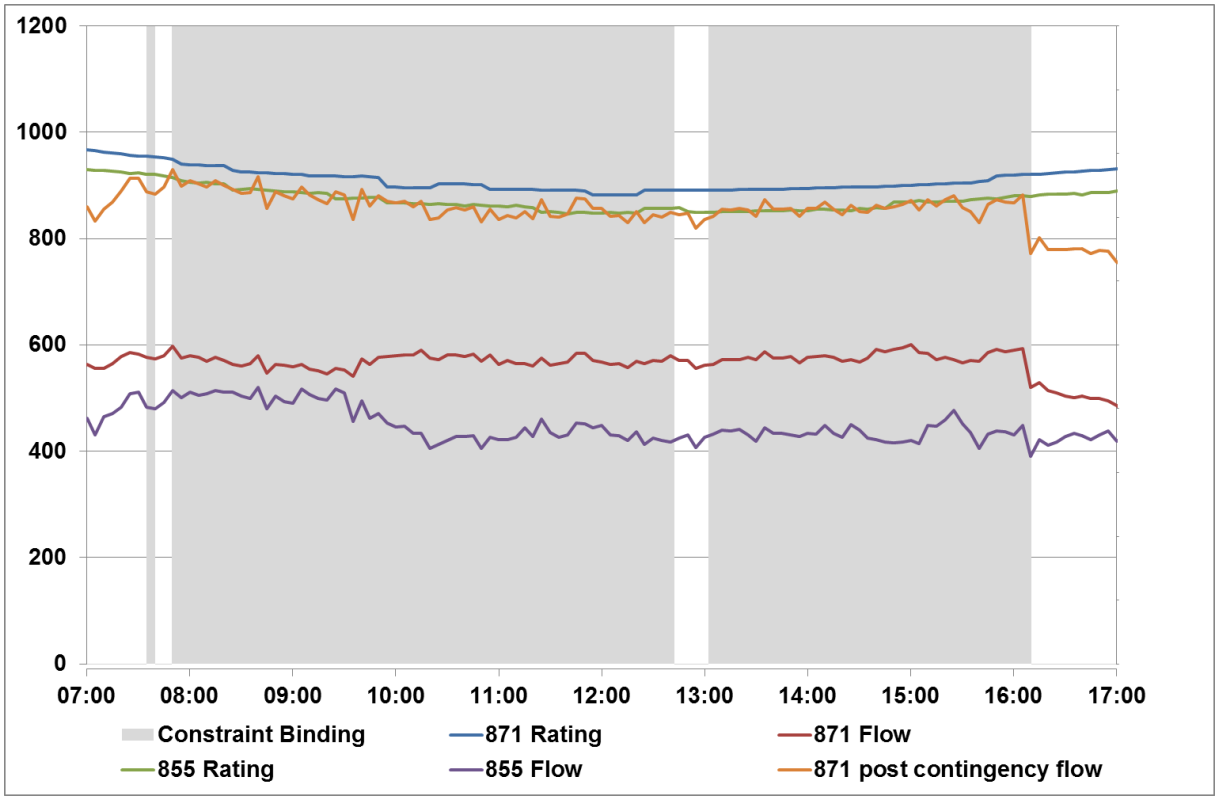


Figure 7b: 13 January 2012 - Gladstone Bids and Queensland Price

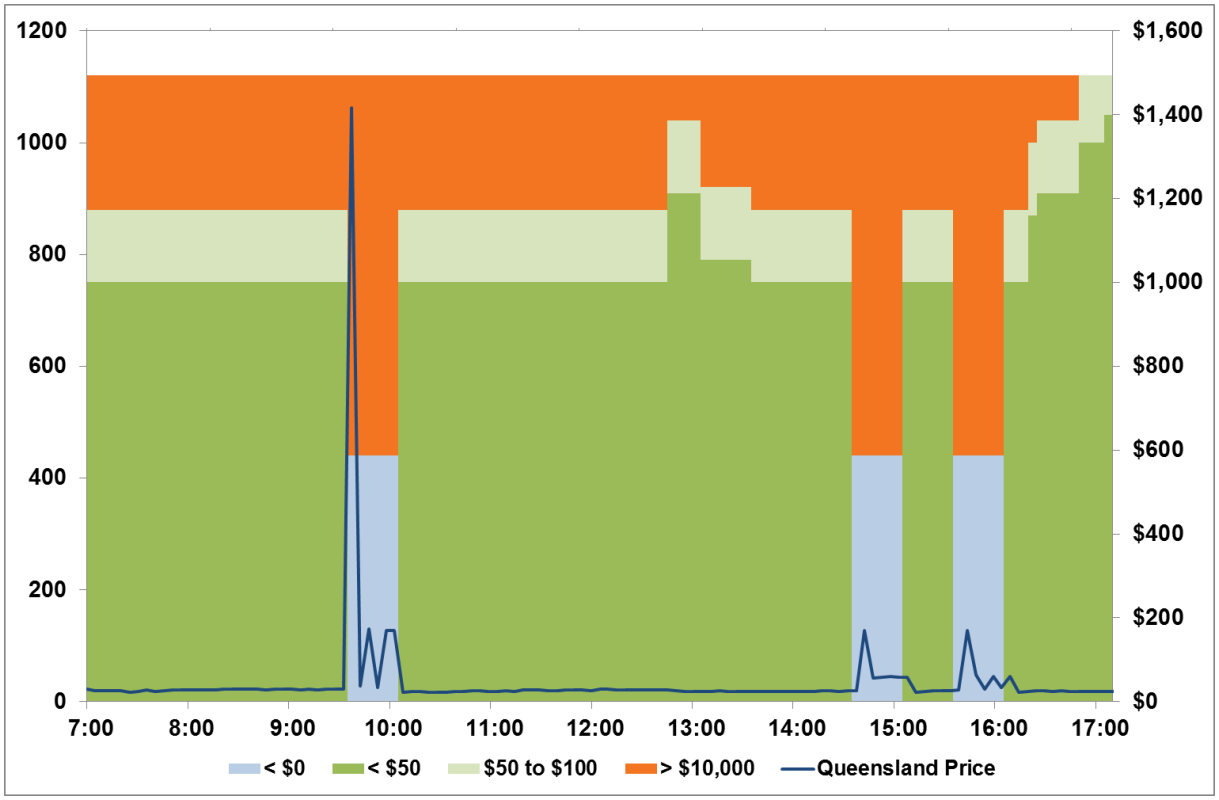
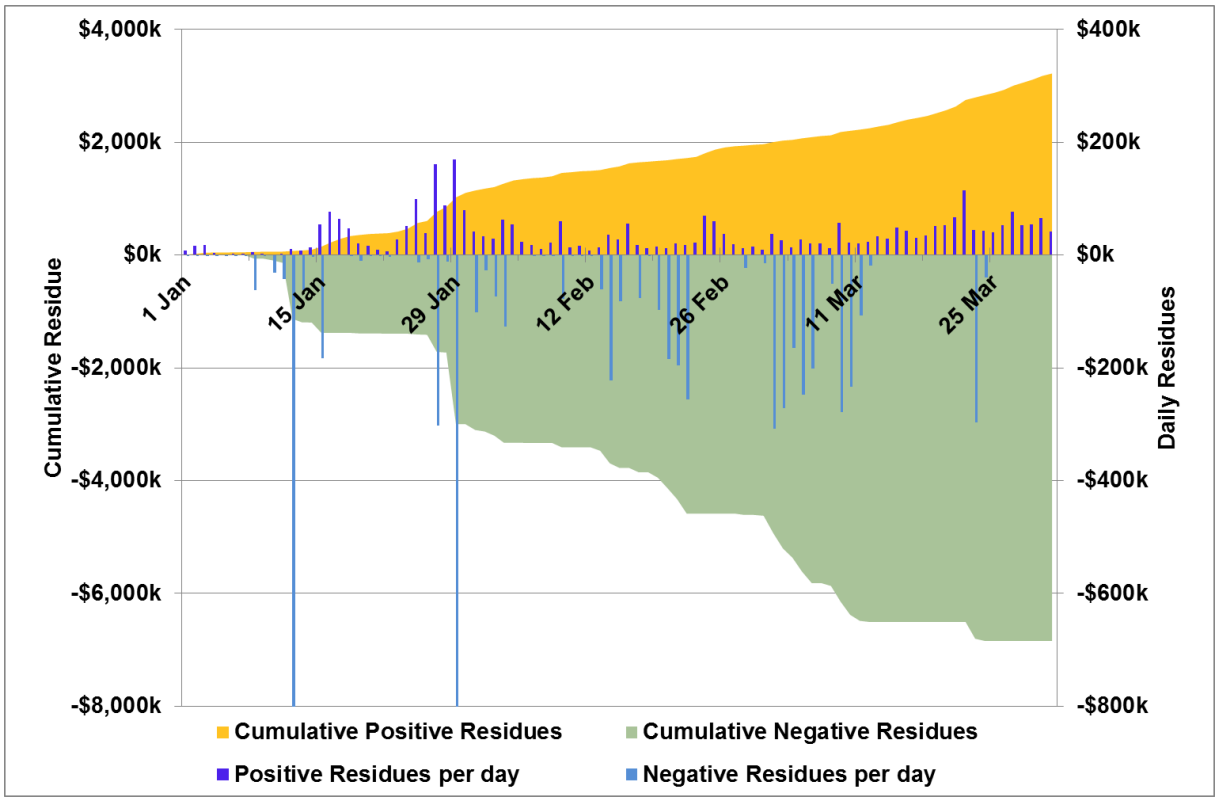


Figure 8: Cumulative Residues – QLD to NSW directional interconnector



5.4 Impact of Constraint Formulation

The current policy for formulating constraints (see Section 4.3 above) is to move terms with coefficients less than 0.07 from the left hand side to the right hand side of constraint equations. Constraint equations that have interconnectors on the left hand side can have market impacts when binding, such as:

- A price difference between the two regions, which is related to the interconnector coefficients and the marginal value of the constraint.
- Perverse price signals such as counter-priced flows[9] between regions, particularly where the region boundary does not coincide with the location of the network congestion.
- Where an interconnector coefficient is small (that is, close to 0.07), a disproportionate impact on interconnector flow compared to the congestion being managed.

All the above impacts can be amplified by bidding responses.

An alternative policy, to have a different threshold for interconnectors compared to other regionally based terms, would have significantly changed the market outcomes described in this report. In this case, the Queensland price would have stayed at close to the New South Wales price (after allowing for losses), the incentive to rebid would have been removed and there would not have been counter-priced flows. However, this would have reduced the constraint equations effectiveness at managing the congestion and require a larger operating margin to ensure power system security could be maintained.

Changing the policy on formulation of constraints is not being considered at this stage.

[9] That is flow from a high-priced region to a low-priced region, resulting in a settlement deficit that is paid for by the importing region's TNSP initially and recovered through transmission use of system charges.

5.5 Pre-dispatch Forecasts

AEMO publishes forecasts of prices through the Pre-dispatch and 5-minute Pre-dispatch schedules.

Neither the Pre-dispatch nor 5-minute Pre-dispatch provided forecasts of the impact of the binding 855/871 constraint equations on Queensland prices, as the price changes were caused by either short notice rebidding, or by changes to the dynamic ratings of 855 and 871 lines that are not reflected in those processes.

A concern shared by AEMO and market participants is the current inability to forecast rating changes and the associated market impacts in Pre-dispatch. AEMO has implemented a new short term demand forecasting platform (DFS) at the end of 2011. This forecasting platform includes actual and forecast weather conditions at 16 weather stations across the NEM, and has the functionality for more stations to be added. AEMO recognised the ability to create a model to forecast line ratings based on these weather inputs, and feed these ratings directly into the dispatch process to be used in constraint equations. AEMO is currently developing this model, and is in the process of obtaining historical data sets to test the possibility of forecasting dynamic ratings in the DFS. The dynamic ratings for 855 and 871 lines will be included in the test scenarios.

6 Transmission Frameworks Review and Disorderly Bidding

The AEMC, Australian Energy Regulator and AEMO have commented on incentives on market participants to bid in a disorderly way in the AEMC's transmission frameworks review. This section places those comments in the context of the transmission frameworks review.

AEMO's view, discussed in a submission to the review, is that it is economically acceptable to have some degree of congestion on the network. Disorderly bidding provides a false signal to create or worsen congestion at times that are not economically acceptable, or to remove congestion that should rightly be signalled to the market. AEMO considers that aspects of the market design poorly manage congestion and utilisation of the transmission network.

In its transmission frameworks review, AEMC has considered a number of possible approaches ("packages") for the allocation of access rights to transmission. The events of summer 2012 in Queensland are an example of the issues faced by the market from not having an adequate market model to allocate access. AEMO has indicated in its submission that the capacity-based allocation (package 2 in the AEMC's first interim report) or, more preferably, a market-based tradeable access right allocation (package 4) would address the issues identified in this report.

7 Recommendations

AEMO believes that market design changes should be considered to better manage transmission constraints and recommends interested parties note the events of summer 2012 in Queensland in the context of the AEMC's transmission frameworks review.

Reformulation of network constraints to allow interconnectors with coefficients larger than 0.07 to be moved to the right had side of network constraint equations has not been considered at this stage. Although this might reduce the market impact of such events, it would also reduce the effectiveness of constraints to manage power system security.

Appendix – Constraint Formulations

(Note that the Wivenhoe and Swanbank power stations are not in the constraint equation because the "factors" of the generator terms are less than 0.07, i.e. they contribute very little to the congestion on the 855/871 lines[10].)

Constraint Equation: Q>>NIL_855_871

Constraint type: LHS<=RHS
Constraint description: Out = Nil, avoid overload on Calvale to Wurdong (871) line on trip of Calvale to Stanwell (855) line, Feedback
Impact: Qld Generation + Interconnectors
Limit type: Thermal
Reason: Trip of Calvale to Stanwell (855) line

LHS =
+1.0000 x Callide B and C
-0.9657 x Gladstone units 3 and 4
-0.9315 x Gladstone units 1, 2, 5 and 6
-0.8245 x Stanwell
-0.7531 x Barron Gorge hydro
-0.7530 x Kareeya hydro
-0.7526 x Townsville GT (Yabulu)
-0.7520 x Mt Stuart GT
-0.7477 x Mackay GT
-0.7455 x Collinsville
-0.5548 x Barcaldine GT
+0.1595 x Tarong, Tarong North, Condamine and Roma
+0.1379 x Braemar 1, Braemar 2, Kogan Creek, Darling Downs
+0.1246 x MW flow north on the QNI AC Interconnector
+0.1195 x Millmerran
+0.1060 x Oakey GT

Dispatch RHS =
2.862 x **(** -1 x [MVA on 871 275kV feeder from Calvale, Line end switched MW]
- 0.645 x [MW flow on 855 275kV feeder at Calvale, Line end switched MW]
+ Qld: 871 Calvale to Wurdong 275kV Emergency Rating
- 35 {Operating Margin}**)**
- 0.9315 x [Gladstone unit 1]
- 0.9315 x [Gladstone unit 2]
- 0.9657 x [Gladstone unit 3]
- 0.9657 x [Gladstone unit 4]
- 0.9315 x [Gladstone unit 5]
- 0.9315 x [Gladstone unit 6]
+ 0.1595 x [Tarong unit 1]
+ 0.1595 x [Tarong unit 2]
+ 0.1595 x [Tarong unit 3]
+ 0.1595 x [Tarong unit 4]
+ Callide B unit 1
+ Callide B unit 2
- 0.8245 x [Stanwell unit 1]
- 0.8245 x [Stanwell unit 2]
- 0.8245 x [Stanwell unit 3]
- 0.8245 x [Stanwell unit 4]

[10] Refer to the Constraints Formulation Guidelines, §5.5.1. http://www.aemo.com.au/electricityops/0100-0009.pdf

+ 0.1379 x [Braemar 1 GT unit 1]
+ 0.1379 x [Braemar 1 GT unit 2]
+ 0.1379 x [Braemar 1 GT unit 3]
+ 0.1379 x [Kogan Creek]
+ 0.1379 x [Braemar 2 GT unit 5]
+ 0.1379 x [Braemar 2 GT unit 6]
+ 0.1379 x [Braemar 2 GT unit 7]
+ 0.1379 x [Darling Downs GT]
+ 0.1595 x [Condamine CCGT]
+ Callide C unit 3
+ Callide C unit 4
+ 0.1595 x [Tarong North]
- 0.7531 x [Barron Gorge hydro unit 1]
- 0.7531 x [Barron Gorge hydro unit 2]
- 0.7455 x [Collinsville unit 1]
- 0.7455 x [Collinsville unit 2]
- 0.7455 x [Collinsville unit 3]
- 0.7455 x [Collinsville unit 4]
- 0.7455 x [Collinsville unit 5]
- 0.753 x [Kareeya hydro unit 1]
- 0.753 x [Kareeya hydro unit 2]
- 0.753 x [Kareeya hydro unit 3]
- 0.753 x [Kareeya hydro unit 4]
- 0.7526 x [Townsville GT (Yabulu) unit 2]
- 0.7526 x [Townsville GT (Yabulu) unit 1]
+ 0.1595 x [Roma GT unit 7]
+ 0.1595 x [Roma GT unit 8]
+ 0.1195 x [Millmerran unit 1]
+ 0.1195 x [Millmerran unit 2]
- 0.5548 x [Barcaldine GT]
- 0.7477 x [Mackay GT]
- 0.752 x [Mt Stuart GT unit 1]
- 0.752 x [Mt Stuart GT unit 2]
- 0.752 x [Mt Stuart GT unit 3]
+ 0.106 x [Oakey GT unit 1]
+ 0.106 x [Oakey GT unit 2]
+ 0.1246 x [MW flow north on the QNI AC Interconnector]

Pre-dispatch RHS =
2.862 x **(** Qld: 871 Calvale to Wurdong 275kV Emergency Rating
+ 0.0124 x [Southern Queensland Area]
- 0.312 x [Central Queensland Area]
- 0.3096 x [Northern Queensland Area]
+ 135.61 {Constant}
- 35 {Operating Margin}**)**

Constraint Equation: Q>>NIL_871_855

Constraint type: LHS<=RHS
Constraint description: Out= Nil, avoid O/L 855 Calvale to Stanwell 275kV line on trip of 871 Calvale to Wurdong 275kV line, Feedback
Impact: Qld Generation + Interconnectors
Limit type: Thermal
Reason: Trip of Calvale to Wurdong (871) line

LHS =

-0.8011 x Barcaldine GT
0.0773 x Millmerran unit 1
0.0773 x Millmerran unit 2
-0.9276 x Barron Gorge hydro unit 1
-0.9276 x Barron Gorge hydro unit 2
0.08963 x Braemar 1 GT unit 1
0.08963 x Braemar 1 GT unit 2
0.08963 x Braemar 1 GT unit 3
0.08963 x Kogan Creek
0.08963 x Braemar 2 GT unit 5
0.08963 x Braemar 2 GT unit 6
0.08963 x Braemar 2 GT unit 7
0.08963 x Darling Downs GT
0.6529 x Callide B unit 1
0.6529 x Callide B unit 2
0.6529 x Callide C unit 3
0.6529 x Callide C unit 4
0.1041 x Condamine CCGT
-0.9118 x Collinsville unit 1
-0.9118 x Collinsville unit 2
-0.9118 x Collinsville unit 3
-0.9118 x Collinsville unit 4
-0.9118 x Collinsville unit 5
-0.9268 x Townsville GT (Yabulu) unit 2
-0.6314 x Gladstone unit 1
-0.6314 x Gladstone unit 2
-0.5696 x Gladstone unit 3
-0.5696 x Gladstone unit 4
-0.6314 x Gladstone unit 5
-0.6314 x Gladstone unit 6
-0.9276 x Kareeya hydro unit 1
-0.9276 x Kareeya hydro unit 2
-0.9276 x Kareeya hydro unit 3
-0.9276 x Kareeya hydro unit 4
-0.9191 x Mackay GT
-0.9265 x Mt Stuart GT unit 1
-0.9265 x Mt Stuart GT unit 2
-0.9265 x Mt Stuart GT unit 3
0.1041 x Roma GT unit 7
0.1041 x Roma GT unit 8
- Stanwell unit 1
- Stanwell unit 2
- Stanwell unit 3
- Stanwell unit 4
0.1041 x Tarong North
0.1041 x Tarong unit 1
0.1041 x Tarong unit 2
0.1041 x Tarong unit 3
0.1041 x Tarong unit 4
-0.9267 x Townsville GT (Yabulu) unit 1
0.08076 x MW flow north on the QNI AC Interconnector

Dispatch RHS =

2.472 x (Qld: 855 Calvale to Stanwell 275kV Continuous Rating
- MW flow on 855 275kV feeder at Calvale, Line end switched MW
- 0.58 x [MVA on 871 275kV feeder from Calvale, Line end switched MW]
- 35 {Operating Margin})
- 0.6314 x [Gladstone unit 1]
- 0.6314 x [Gladstone unit 2]

- 0.5696 x [Gladstone unit 3]
- 0.5696 x [Gladstone unit 4]
- 0.6314 x [Gladstone unit 5]
- 0.6314 x [Gladstone unit 6]
+ 0.1041 x [Tarong unit 1]
+ 0.1041 x [Tarong unit 2]
+ 0.1041 x [Tarong unit 3]
+ 0.1041 x [Tarong unit 4]
+ 0.6529 x [Callide B unit 1]
+ 0.6529 x [Callide B unit 2]
- Stanwell unit 1
- Stanwell unit 2
- Stanwell unit 3
- Stanwell unit 4
+ 0.08963 x [Braemar 1 GT unit 1]
+ 0.08963 x [Braemar 1 GT unit 2]
+ 0.08963 x [Braemar 1 GT unit 3]
+ 0.08963 x [Kogan Creek]
+ 0.08963 x [Braemar 2 GT unit 5]
+ 0.08963 x [Braemar 2 GT unit 6]
+ 0.08963 x [Braemar 2 GT unit 7]
+ 0.08963 x [Darling Downs GT]
+ 0.1041 x [Condamine CCGT]
+ 0.6529 x [Callide C unit 3]
+ 0.6529 x [Callide C unit 4]
+ 0.1041 x [Tarong North]
- 0.9276 x [Barron Gorge hydro unit 1]
- 0.9276 x [Barron Gorge hydro unit 2]
- 0.9118 x [Collinsville unit 1]
- 0.9118 x [Collinsville unit 2]
- 0.9118 x [Collinsville unit 3]
- 0.9118 x [Collinsville unit 4]
- 0.9118 x [Collinsville unit 5]
- 0.9276 x [Kareeya hydro unit 1]
- 0.9276 x [Kareeya hydro unit 2]
- 0.9276 x [Kareeya hydro unit 3]
- 0.9276 x [Kareeya hydro unit 4]
- 0.9268 x [Townsville GT (Yabulu) unit 2]
- 0.9267 x [Townsville GT (Yabulu) unit 1]
+ 0.1041 x [Roma GT unit 7]
+ 0.1041 x [Roma GT unit 8]
+ 0.0773 x [Millmerran unit 1]
+ 0.0773 x [Millmerran unit 2]
- 0.8011 x [Barcaldine GT]
- 0.9191 x [Mackay GT]
- 0.9265 x [Mt Stuart GT unit 1]
- 0.9265 x [Mt Stuart GT unit 2]
- 0.9265 x [Mt Stuart GT unit 3]
+ 0.08076 x [MW flow north on the QNI AC Interconnector]

Pre-dispatch RHS =

2.472 x (Qld: 855 Calvale to Stanwell 275kV Continuous Rating
+ 0.0173 x [Southern Queensland Area]
- 0.3777 x [Central Queensland Area]
- 0.4401 x [Northern Queensland Area]
+ 246.5234 {Constant}
- 35 {Operating Margin})