

# MARKET EVENT REPORT: 31 DECEMBER 2009

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## Table of Contents

1	Introduction .....	3
2	Summary of Events.....	3
2.1	Pricing Outcomes: Energy and FCAS.....	3
2.2	Over-Constrained Dispatch (OCD) .....	5
2.3	Other Market Impacts.....	5
3	Basslink MNSP Flow.....	6
4	Generating Plant Offers .....	7
5	Tasmanian FCAS requirement.....	7
6	Conclusion .....	8
7	Recommendations .....	8
8	Appendix A – Glossary of Abbreviations .....	10

## 1 Introduction

The Tasmania Raise 6-second (R6) Frequency Control Ancillary Service (FCAS) prices rose to \$10,000/MW/h between DI 19:40hrs and DI 21:10hrs on Thursday, 31 December 2009. Intervention pricing was triggered when a direction was issued to Tungatindah to supply R6 FCAS from DI 20:35hrs to DI 21:15hrs. Energy and FCAS prices in other regions were not materially affected.

The Tasmanian region experienced a shortage of R6 FCAS during the period when the outages of two double-circuit transmission lines were classified as credible contingencies for overlapping periods due to lightning in the vicinity. The reclassified lines were Farrell to Sheffield No.1 and No.2 220kV from 19:25hrs to 21:40hrs and Chapel Street to Gordon No.1 and No.2 220kV from 19:30hrs to 21:10hrs. Due to the reclassifications, a number of Tasmanian generators were not permitted to provide R6 FCAS as they would be disconnected from the Tasmanian network on the loss of the lines.

During the event, John Butters and Bastyan units tripped at 19:30hrs and 20:08hrs respectively following the trip of the associated transmission lines. The units were returned to service by 19:44hrs and 21:07hrs respectively.

To manage the shortage of R6 FCAS, several constraint equations were invoked in steps to reduce the Basslink MNSP flow from its target southwards flow of approximately 260MW at DI 20:10hrs down to 150MW. This lowered the Tasmanian R6 requirement from 60MW to approximately 48MW by DI 20:45hrs. The direction issued to Tungatindah provided an additional 9MW of R6 in Tasmania.

This report examines the market outcomes during this period.

## 2 Summary of Events

### 2.1 Pricing Outcomes: Energy and FCAS

Tasmania experienced high FCAS prices on the evening of 31 December 2009 while the energy price was not materially affected. Figure 1 and Table 1 show the energy prices in the NEM during the period in question. The energy price in Tasmania rose to \$250.16/MWh at DI 20:20hrs when the flow into Tasmania on the Basslink MNSP reduced by 68MW. At this dispatch interval, a constraint equation that was invoked to limit the Basslink MNSP flow to 250MW bound. Further details on the management of Basslink flow are discussed in Section 3.

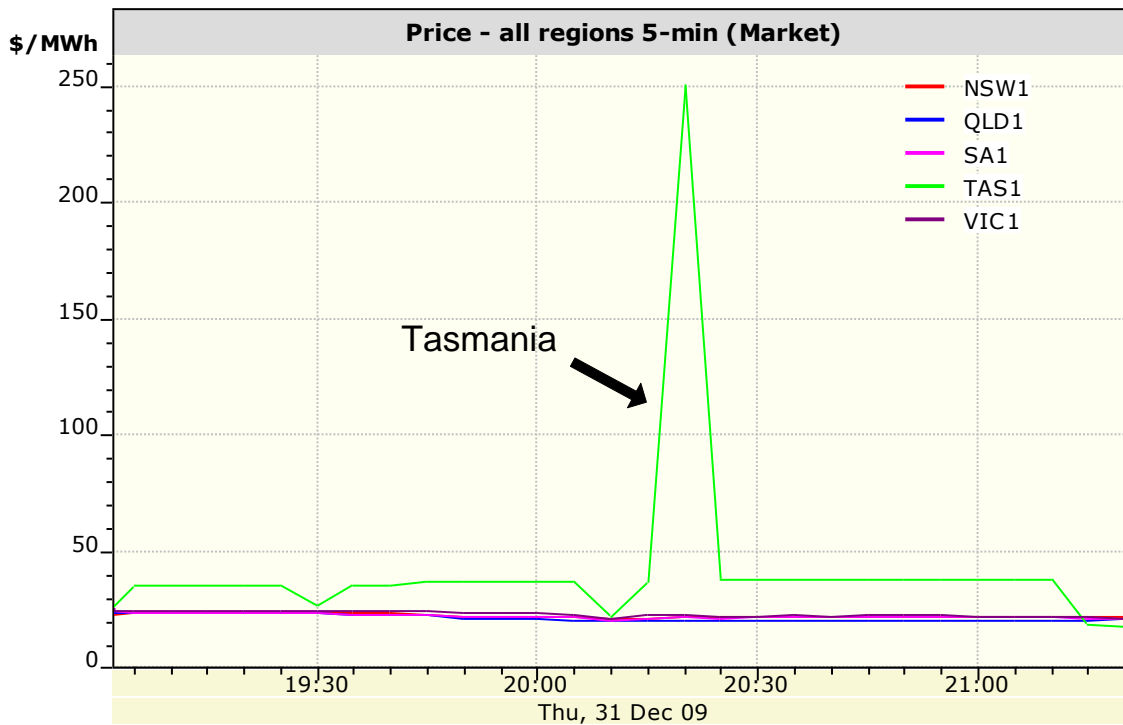


Figure 1 Dispatch Prices for All Regions (\$/MWh)

Trading Interval	NSW	QLD	SA	TAS	VIC
31/12/2009 20:00:00	22.78	22.21	22.85	36.69	24.35
31/12/2009 20:30:00	21.76	20.71	21.68	70.57	22.67
31/12/2009 21:00:00	22.06	20.86	22.4	38.21	22.77
31/12/2009 21:30:00	22.01	20.93	21.53	25.36	21.77

Table 1 Trading Interval Price Table (\$/MWh)

The Tasmania R6 FCAS prices rose to \$10,000/MW/h between DI 19:40hrs and DI 21:10hrs on 31 December 2009, as shown in Figure 2. During this period, the Tasmanian region experienced a shortage of R6 FCAS. This coincided with the period when the outages of two double-circuit transmission lines were classified as credible contingencies for overlapping periods due to lightning in the vicinity. Section 5 provides a more detailed analysis on the shortage of R6 in Tasmania.

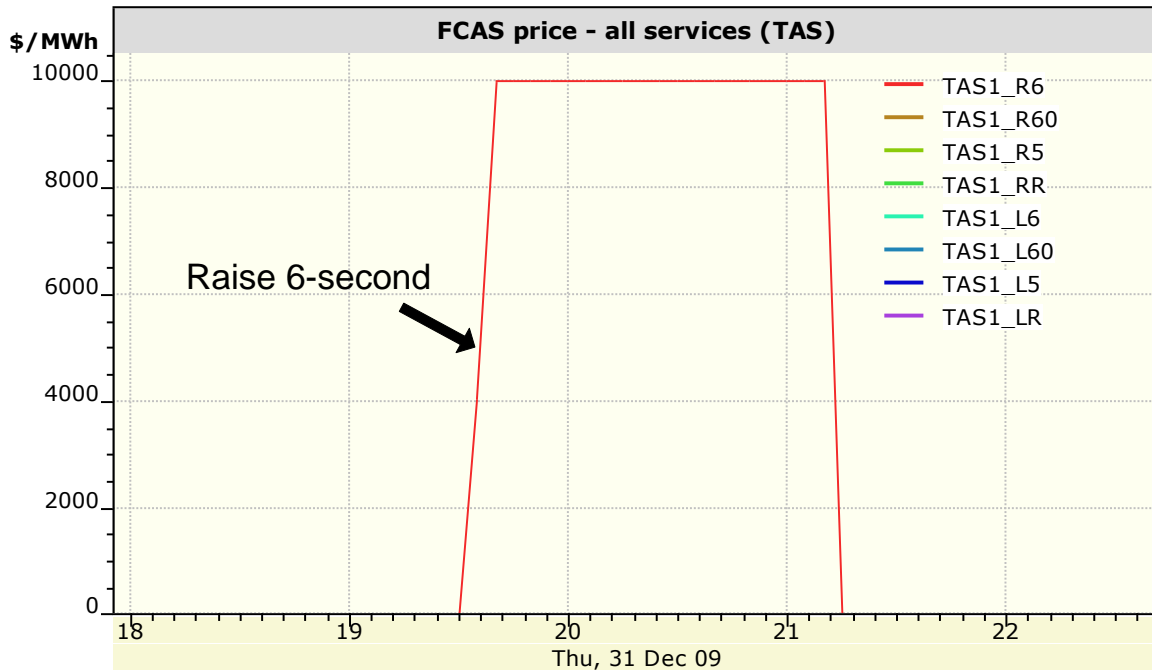


Figure 2 FCAS Dispatch Prices in Tasmania

## 2.2 Over-Constrained Dispatch (OCD)

An automatic Over-Constrained Dispatch (OCD) run was triggered for every DI from DI 19:35hrs to 21:10hrs. The OCD<sup>1</sup> re-runs are triggered when constraint equations violate and the original dispatch price is either above the market cap price or below the market floor price. The automatic OCD process relaxes the constraint equation by the violation amount, then re-runs the NEMDE solver. A manual OCD process is required if, after the automatic process, an eligible constraint equation is violated and the calculated dispatch price is still either above the market cap price or below the market floor price. The manual process is carried out by the end of the next business day. The price solution from the last OCD process is used for the settlement calculation.

Constraint equation F\_T+NIL\_BL\_R6\_1 violated continuously from DIs 20:40hrs to 21:10hrs. During the period under review, the automatic OCD process resolved the solution for all dispatch intervals other than DI 21:10hrs. By the last interval (DI 21:10hrs) the FCAS violation timer expired in accordance with the business specification and the automatic OCD re-run process did not relax the FCAS requirement constraint equation violation. This is consistent with the automatic OCD relaxation process design for intervention pricing runs. After 30 minutes of a security violation, load shedding or other additional intervention should have been invoked to remove the violation, and so the process of relaxing violated constraint equations is limited to 6 consecutive dispatch intervals for intervention pricing runs.

## 2.3 Other Market Impacts

A direction was issued from 20:22hrs to 21:12hrs to Tungatinah station to provide an additional 9MW of R6 FCAS in Tasmania. Relevant constraint equations to manage the direction were

<sup>1</sup> See “Over-Constrained Dispatch Process Stage 1 Changes: Business Specification” (<http://www.aemo.com.au/electricityops/140-0075.html>)

invoked from DI 20:35hrs to DI 21:15hrs. Details of the direction will be published in a separate direction report.

Intervention pricing was triggered from DI 20:35hrs to DI 21:15hrs. Intervention pricing<sup>2</sup> sets the energy and FCAS prices for all regions based on dispatch that would have occurred in the absence of the direction. The intervention pricing run uses initial values for scheduled units in all regions derived from the target values of those units of the intervention run for the previous dispatch interval, while the outturn run (which determines generator and MNSP dispatch targets) uses the latest SCADA values as initial MW.

The price difference between the intervention and outturn run outcomes in Tasmania was minimal other than the R6 price. Table 2 shows the price differences for R6 FCAS. The R6 price in the outturn run reduced to \$4282.67/MW/h when there was sufficient R6 FCAS to meet the requirement with the additional 9MW from Tungatinah.

Settlement Date	R6 RRP \$ (Intervention Pricing)	R6 RRP \$ (Outturn run)
31/12/2009 20:35	10000	10000
31/12/2009 20:40	10000	10000
31/12/2009 20:45	10000	4282.67
31/12/2009 20:50	10000	4282.67
31/12/2009 20:55	10000	4282.67
31/12/2009 21:00	10000	4282.67
31/12/2009 21:05	10000	10000
31/12/2009 21:10	10000	10000
31/12/2009 21:15	0.3	0.3

Table 2 Comparison of R6 Prices from Intervention and Outturn Runs (Tasmania)

### 3 Basslink MNSP Flow

Basslink MNSP total cleared flow (MW flow) and limits are shown in Figure 3. At the start of the high priced intervals, the Basslink MNSP flow from Victoria to Tasmania was near 450MW. This resulted in an R6 requirement of approximately 60MW in Tasmania. To reduce the Tasmanian regional FCAS requirement, several constraint sets were invoked in steps from DI 20:10hrs to DI 21:45hrs to reduce the Basslink flow to 350MW (I-VT-350), 250MW (I-VT\_250) and 150MW (I-VT\_150). With a decrease in the Basslink southwards flow, the Tasmanian R6 requirement decreased to 48MW by DI 20:45hrs.

Only one of the constraint equations which limited the flow to 250MW (VT\_250) bound at DI 20:20hrs. This also resulted in a slight increase in the Tasmanian energy price as higher priced generation in Tasmania had to be dispatched with the decrease in import into Tasmania.

<sup>2</sup> See "Review of Intervention Pricing Methodology – Final Determination" (<http://www.aemo.com.au/electricityops/140-0071.html>)

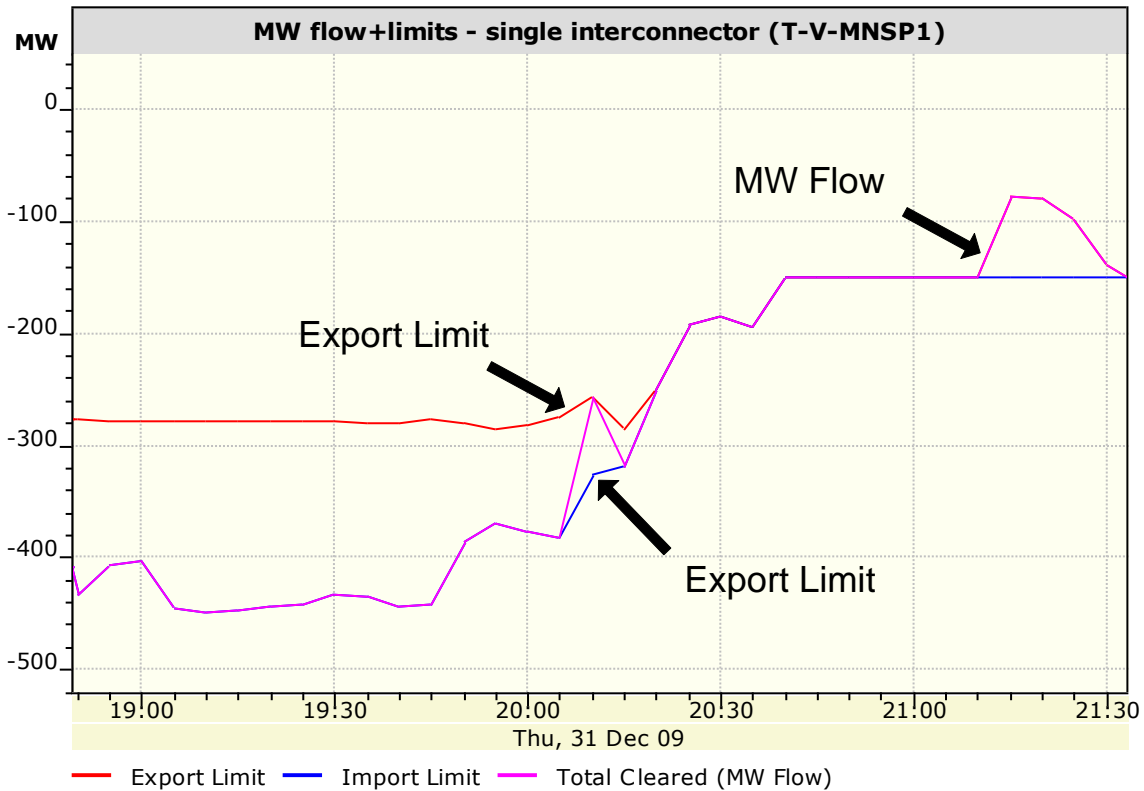


Figure 3 Basslink MNSP Flow and Limits

#### 4 Generating Plant Offers

John Butters and Bastyan units tripped at 19:30hrs and 20:08hrs respectively, following the trip of the associated transmission lines due to lightning. John Butters tripped from 142MW and returned to service by 19:44hrs. Bastyan tripped from 70MW and returned to service by 21:07hrs. It was enabled for 0.52MW of R6 and 33.15MW of L5 prior to the outage.

#### 5 Tasmanian FCAS requirement

Tasmania experienced a shortage of R6 FCAS when the outages of two double-circuit transmission lines were classified as credible contingencies for overlapping periods due to lightning in the vicinity. The reclassified lines were Farrell to Sheffield No.1 and No.2 220kV from 19:25hrs to 21:40hrs and Chapel Street to Gordon No.1 and No.2 220kV from 19:30hrs to 21:10hrs. Figure 4 shows the system diagram of the transmission lines that were reclassified (refer to the dashed lines).

Due to the reclassification constraint equations, a number of Tasmanian generators were not permitted to provide R6 FCAS as they would be disconnected from the Tasmanian network on the loss of the lines. For the reclassification of the Farrell to Sheffield No.1 and No.2 220kV lines, R6 FCAS of Bastyan, John Butters and Reece 2 units were constrained to 0MW by constraint equation  $F\_T+FASH\_N-2\_R6$ . The other units, Tribute and Reece 1 were not constrained as they would be connected to the rest of Tasmania via the Hampshire link. For the reclassification of the Chapel Street to Gordon lines, R6 FCAS of Gordon was constrained to 0MW by constraint equation  $F\_T+T\_CSGO\_R6$ .

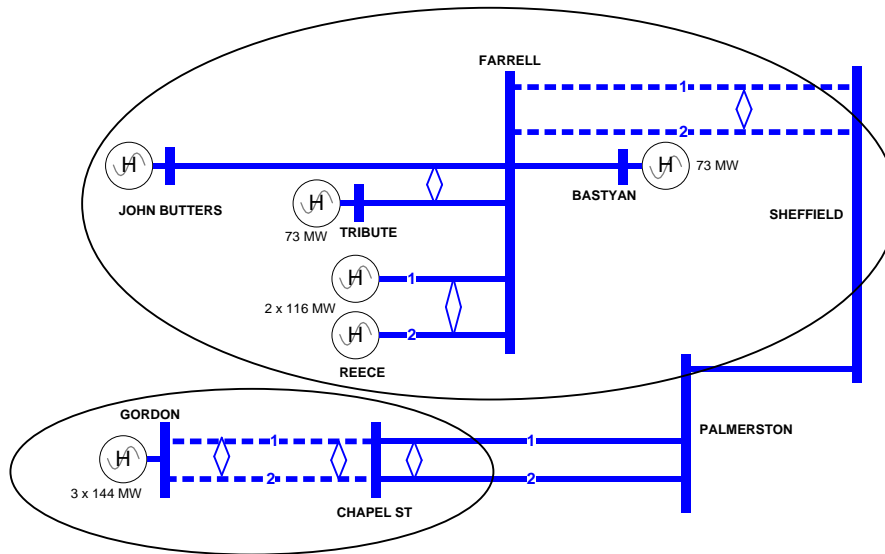


Figure 4 System Diagram of Reclassified Transmission Lines and Relevant Generators

With all the units constrained to 0MW due to the reclassification, the maximum amount of R6 shortage is 34.07MW at DI 19:40hrs. The constraint equation which sets the R6 requirement (F\_T+NIL\_BL\_R6\_1) violated by the corresponding amount. If Bastyan, John Butters and Gordon were not constrained at that interval, the amount of R6 available from those three units for enablement would have been 49.6MW. (Reece 2 did not offer R6 at that period.)

## 6 Conclusion

The Tasmania R6 FCAS prices rose to \$10,000/MW/h between DI 19:40hrs to DI 21:10hrs on 31 December 2009 due to a shortage of R6 FCAS. Energy and FCAS prices in other regions were not materially affected.

Tasmania experienced a shortage of R6 FCAS when a number of Tasmanian generators were not permitted to provide R6 FCAS when two double-circuit transmission lines were reclassified for overlapping periods. To improve the efficiency of R6 dispatch, generators which were constrained to 0MW for one transmission line reclassification should have been able to provide R6 to cover the outage of the other line reclassification. This change in constraint equation formulation was implemented on 15 February 2010.

As the option was unavailable during the event, AEMO managed the shortage of R6 FCAS by firstly reducing Basslink flow with the aim to reduce the Tasmanian R6 requirement. Subsequently, a direction was issued from DI 20:35hrs to DI 21:15hrs to Tungatimah to provide an additional 9MW of R6.

## 7 Recommendations

AEMO recommends modifying existing FCAS constraint sets that are invoked in the event of double-circuit transmission line reclassifications in areas where the impact is material. The event described in this report highlighted the issue of constraining off generators in providing FCAS service, thus resulting in a shortage of R6 FCAS in the region. In such events, generators which were constrained down to 0MW of FCAS should have been permitted to provide FCAS to cover other contingencies such as the risk of the loss of the other set of reclassified lines.



For example, for the reclassification of the Farrell to Sheffield No.1 and No.2 lines, the current constraint set (F-T-FASH\_N-2) invoked had an equation (F\_T+FASH\_N-2\_R6) which required Bastyan, John Butters and Reece 2 to provide 0MW of R6. The new formulation proposes to remove this constraint equation and to modify other R6 constraint equations. The modification will allow the three units to contribute their available R6 FCAS to meet the Tasmanian FCAS requirement. This requirement is to cover the risk of tripping either the Gordon to Chapel Street No.1 and No.2 transmission lines or tripping of Basslink. Table 3 shows the differences between the current and proposed formulation for constraint equations that manage the R6 requirement for constraint set F-T-FASH\_N-2.

Constraint Equation	Current Formulation	Proposed Formulation
F_I+FASH_N-2_TG_R6	$R6_{(TAS)} + R6_{(Mainland)} \geq RHS_1$	$R6_{(TAS)} + R6_{(Main)} - R6_{(Bastyan)} - R6_{(JButters)} - R6_{(Reece)} \geq RHS_1$
F_T++FASH_N-2_TG_R6	$R6_{(TAS)} + Basslink \geq RHS_2$	$R6_{(TAS)} + Basslink - R6_{(Bastyan)} - R6_{(JButters)} - R6_{(Reece)} \geq RHS_2$
F_T+FASH_N-2_TG_R6	$R6_{(TAS)} \geq RHS_3$	$R6_{(TAS)} - R6_{(Bastyan)} - R6_{(JButters)} - R6_{(Reece)} \geq RHS_3$
F_T+FASH_N-2_R6	$R6_{(Bastyan)} + R6_{(JButters)} + R6_{(Reece)} = 0$	nil

Table 3 New Constraint Formulation for Constraint Set F-T-FASH\_N-2

Similarly, for the reclassification of the Gordon to Chapel Street No.1 and No.2 lines, the current constraint set (F-T-CSGO) invoked had a constraint equation (F\_T+T\_CSGO\_R6) which required Gordon to provide 0MW of R6. The new formulation proposes to remove this constraint equation and to modify the other R6 constraint equations. This will allow Gordon to contribute R6 to meet the FCAS requirement. This requirement is to cover the risk of tripping either the Farrell to Sheffield No.1 and No.2 lines or tripping of Basslink. Table 4 shows the differences between the current and proposed formulation for constraint equations that manage the R6 requirement for constraint set F-T-CSGO.

Constraint Equation	Current Formulation	Proposed Formulation
F_I+CSGO_TG_R6	$R6_{(TAS)} + R6_{(Mainland)} \geq RHS_5$	$R6_{(TAS)} + R6_{(Main)} - R6_{(Gordon)} \geq RHS_5$
F_T++CSGO_TG_R6	$R6_{(TAS)} + Basslink \geq RHS_6$	$R6_{(TAS)} + Basslink - R6_{(Gordon)} \geq RHS_6$
F_T+CSGO_TG_R6	$R6_{(TAS)} \geq RHS_7$	$R6_{(TAS)} - R6_{(Gordon)} \geq RHS_7$
F_T+T_CSGO_R6	$R6_{(Gordon)} = 0$	nil

Table 4 New Constraint Formulation for Constraint Set F-T-CSGO

This recommendation was implemented on 15 February 2010. The proposed formulation is applicable to other contingency FCAS services as well.

## 8 Appendix A – Glossary of Abbreviations

ABBREVIATION	MEANING
DI	Dispatch Interval
FCAS	Frequency Control Ancillary Services
L6	Lower 6-second FCAS service
L60	Lower 60-second FCAS service
L5	Lower 5-minute FCAS service
LHS	Left Hand Side
LReg	Lower regulation FCAS service
MNSP	Market Network Service Provider
R6	Raise 6-second FCAS service
R60	Raise 60-second FCAS service
R5	Raise 5-minute FCAS service
RHS	Right Hand Side
RReg	Raise regulation FCAS service
RRP	Regional Reference Price
TI	Trading Interval
TNSP	Transmission Network Service Provider