

# POWER SYSTEM FREQUENCY AND TIME ERROR MONITORING

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## Version Release History

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1.0	17/09/2012	Peter McEnery	Initial release

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## 2 Introduction

AEMO must use reasonable endeavours to maintain the power system frequency and time error within the limits specified in the Frequency Operating Standards determined for the Mainland and the Tasmania Region by the Reliability Panel. This document reports on the frequency and time error performance observed during July 2012 in all regions of the NEM. Queensland, New South Wales, Victoria and South Australia are referred to as the Mainland regions throughout the report.

The Frequency Operating Standards for the Mainland regions and the Tasmania region are available on the AEMC web site<sup>1</sup>.

The "Power System Frequency and Time Deviation Monitoring Report – Reference Guide"<sup>2</sup> outlines the calculation processes used by AEMO in the preparation of the monthly Power System Frequency and Time Deviation Monitoring reports.

The analysis of the delivery of Slow Raise service, Slow Lower service, Delayed Raise service and Delayed Lower service presented in this report are based on 4-second definition data. Unless otherwise noted, frequency data for Mainland regions is sourced from 4-second measurements in New South Wales and frequency data for Tasmania region is sourced from 4-second measurements in Tasmania. The analysis of Fast Raise service and Fast Lower service delivered is based on high-speed (50 millisecond or higher definition) data from Market Participants and is only presented in this report for events where the appropriate data is available.

## 3 Operation within the Normal Operating Frequency Band

During July 2012 the Mainland frequency was within the Normal Operating Frequency Band (49.85 Hz – 50.15 Hz) 99.96% of the time.

During July 2012 the Tasmanian frequency was within the Normal Operating Frequency Band 99.87% of the time.

One frequency excursion within the Normal Operating Frequency Excursion Band (49.75 Hz – 50.25 Hz) did not return to the Normal Operating Frequency Band within the times in the Mainland Frequency Operating Standard. This event is discussed in Section 6.

All frequency excursions within the Normal Operating Frequency Excursion Band returned to the Normal Operating Frequency Band within in the times in the Tasmania Frequency Operating Standard.

## 4 Operation outside Normal Operating Frequency Excursion Band

Table 1 summarises events in the Mainland and Tasmanian regions for the month July 2012 with frequency excursions outside the Normal Operating Frequency Excursion Band.

All Mainland events in Table 1 are consistent with the Mainland Frequency Operating Standard.

Three Tasmania events in Table 1 are not consistent with the Tasmania Frequency Operating Standard. These events are discussed in Section 6.

<sup>1</sup> The Frequency Operating Standards for the Mainland and Tasmania regions are available from <http://www.aemc.gov.au/Panels-and-Committees/Reliability-Panel/Guidelines-and-standards.html>

<sup>2</sup> The Power System Frequency and Time Deviation Monitoring Report – Reference Guide is available from <http://www.aemo.com.au/Electricity/Market-and-Power-Systems/NEM-Reports/Power-System-Performance-Monitoring>

## 5 Events outside Normal Operating Frequency Excursion Band

Table 1: Events in the Mainland and Tasmanian regions with frequency excursions outside the Normal Operating Frequency Excursion Band.

EVENT	LOW/HIGH FREQUENCY EVENT	NUMBER OF EVENTS	
		MAINLAND	TASMANIA
No contingency or load event/Normal event	LOW	0	2
	HIGH	0	2
Load Event	LOW	0	18
	HIGH	0	17
Generation Event	LOW	0	1
	HIGH	0	0
Network Event	LOW	1	1
	HIGH	0	3
Separation Event	LOW	0	0
	HIGH	0	0
Multiple Contingency Event	LOW	0	0
	HIGH	0	0

## 6 Events that did not meet the Frequency Operating Standards

In this section, details are provided of those events identified as not meeting the Frequency Operating Standard applicable to each event.

### 6.1 Low frequency events in Mainland regions

There was one low frequency event recorded in the Mainland Region that did not meet the Mainland Frequency Operating Standard during July 2012. This event is listed in Table 2.

*Table 2: Low frequency events in the Mainland region during which frequency exceeded the Mainland Frequency Operating Standards.*

DATE	EVENT	MIN FREQUENCY (HZ)	TIME OUTSIDE NORMAL OPERATING BAND (49.85 HZ - 50.15 HZ)(SECONDS)
02/07/2012 12:28:24	No Condition causing the event was identified.	49.76	584

#### 6.1.1 Event: 02/07/2012 12:28:24

No contingency could be identified as the cause of this event. Figure 1 shows that the Mainland frequency was outside the Normal Operating Frequency Band for 584 seconds. The Mainland frequency fell to a minimum of 49.76 Hz during this event. The Mainland frequency had previously recovered from the trip of Basslink exporting to Victoria at 1217 hours. After the frequency had recovered, six Victorian generating units were persistently operating below their dispatch targets which contributed to the subsequent frequency excursion. Basslink had previously tripped and remained out of service during this event.

A comparison of the amount of Enabled Slow Raise and Delayed Raise FCAS, and the amounts delivered is shown in Figure 2. The frequency excursion was not sufficient to trigger switched controllers to deliver Delayed Raise FCAS during this event. The amount of Fast Raise services delivered was not calculated as high speed data was not requested for this event.

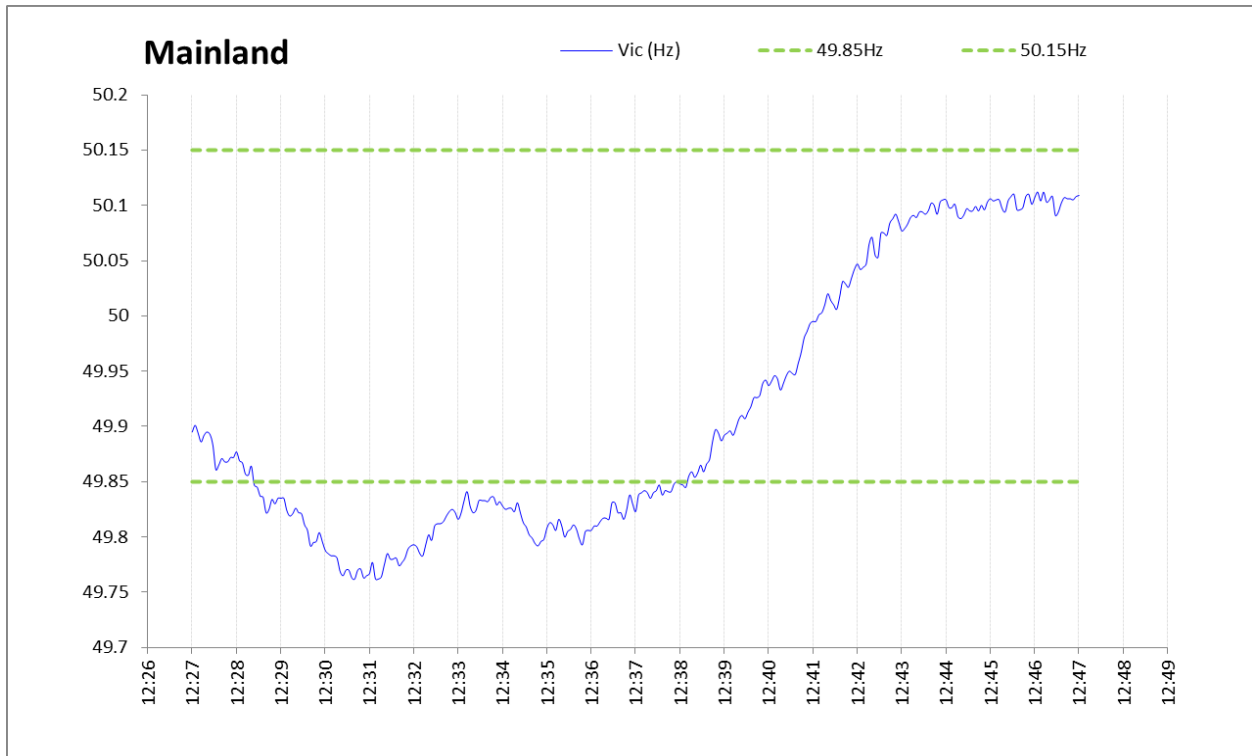


Figure 1: Low frequency no contingency event in Mainland that occurred 02/07/2012 12:28:24

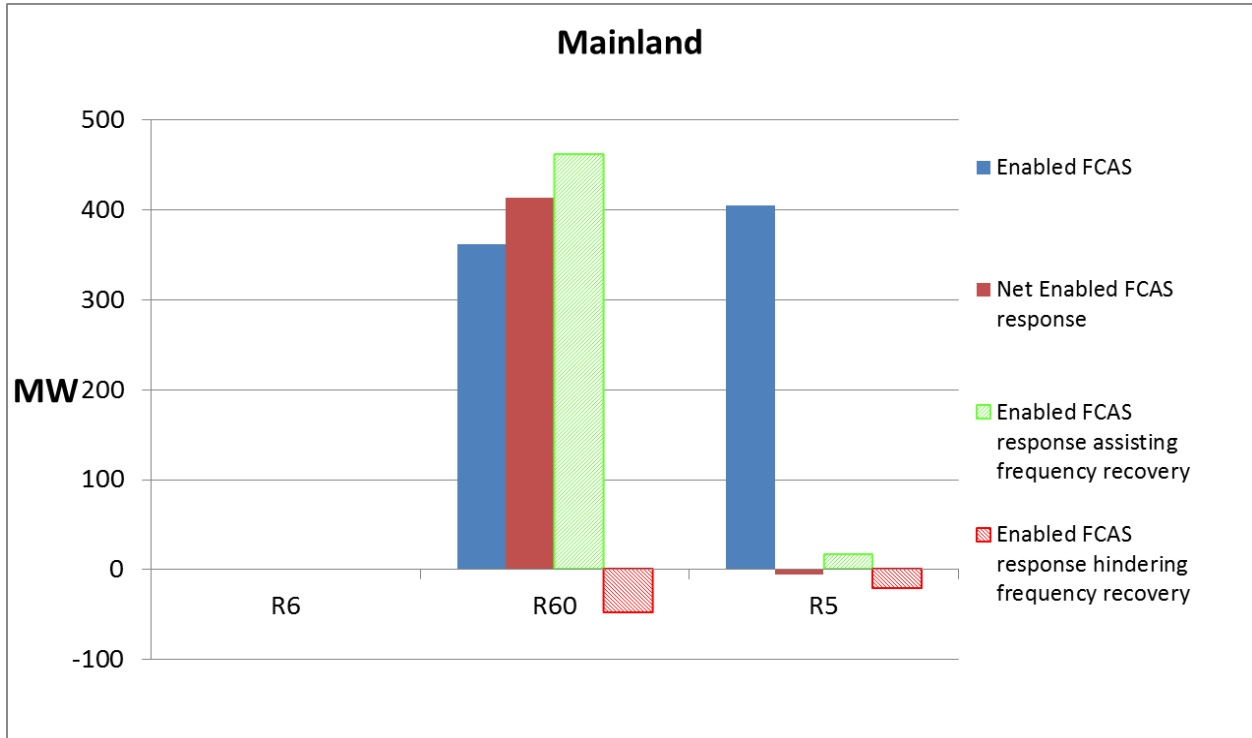


Figure 2: FCAS response to no contingency Mainland event that occurred 02/07/2012 12:28:24.



## 6.2 High frequency events in Mainland regions

There were no high frequency events in the Mainland regions not meeting the Mainland Frequency Operating Standard during July 2012.

## 6.3 Low frequency events in Tasmania

There were two low frequency events from Table 1 recorded in the Tasmania region during July 2012 that did not meet the Tasmania Frequency Operating Standard. These events are listed in Table 3.

*Table 3: Low frequency events in the Tasmania region where frequency exceeded the Tasmania Frequency Operating Standards.*

DATE	EVENT	MIN FREQUENCY (HZ)	TIME OUTSIDE NORMAL OPERATING BAND (49.85 HZ - 50.15 HZ)(SECONDS)
02/07/2012 13:11:36	No Condition causing the event was identified.	49.71	16
05/07/2012 20:41:52	No Condition causing the event was identified.	49.72	24

### 6.3.1 Event: 02/07/2012 13:11:36

No contingency could be identified as the cause of the event on 02 July 2012 in Tasmania. Figure 3 shows that the Tasmania region frequency exceeded the Tasmania Frequency Operating Standards, and was outside the Normal Operating Frequency Band for 16 seconds. Frequency fell to a minimum of 49.71 Hz in the Tasmania Region. Two Tasmanian generating units were coming offline from 5 MW each during the event which contributed to the frequency excursion. Basslink was in service but not transmitting power during this event.

Compared to the enabled Slow Raise and Delayed Raise FCAS, nil amounts were delivered as shown in Figure 4. Nil amounts were delivered because the frequency returned to the Normal Operating Frequency Band in 16 seconds. The amount of Fast Raise services delivered was not calculated as high speed data was not requested for this event.

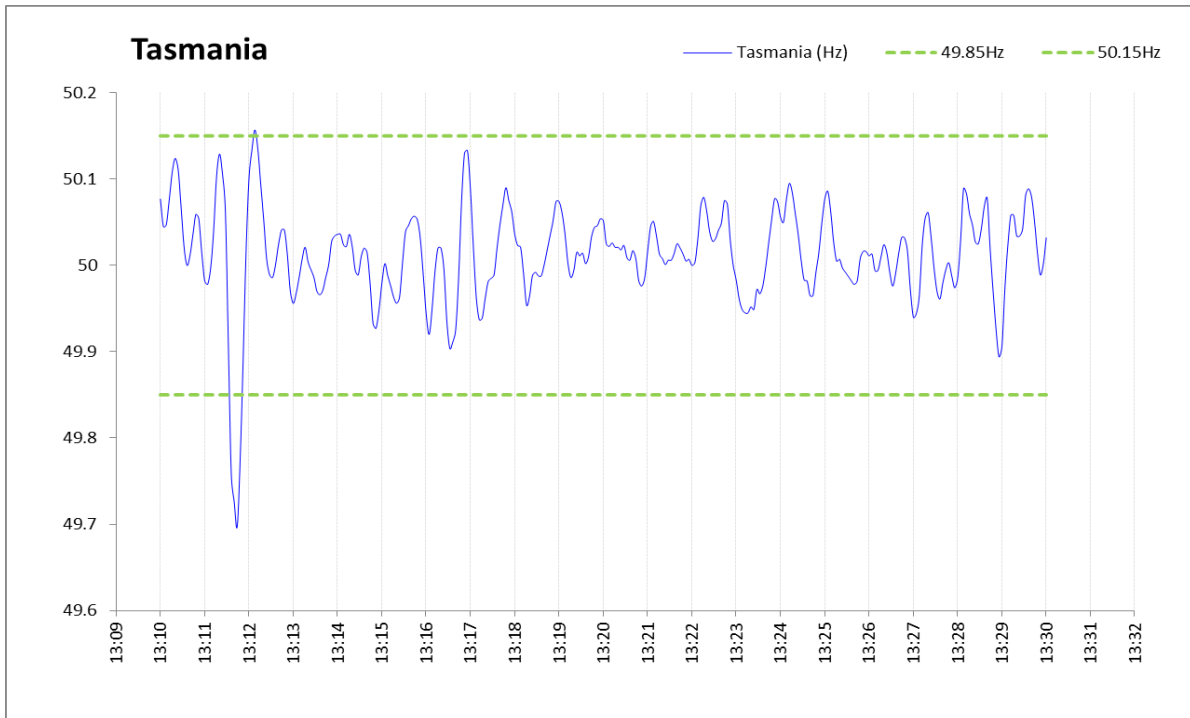


Figure 3: Low frequency Normal Condition event in Tasmania 02/07/2012 13:11:36.

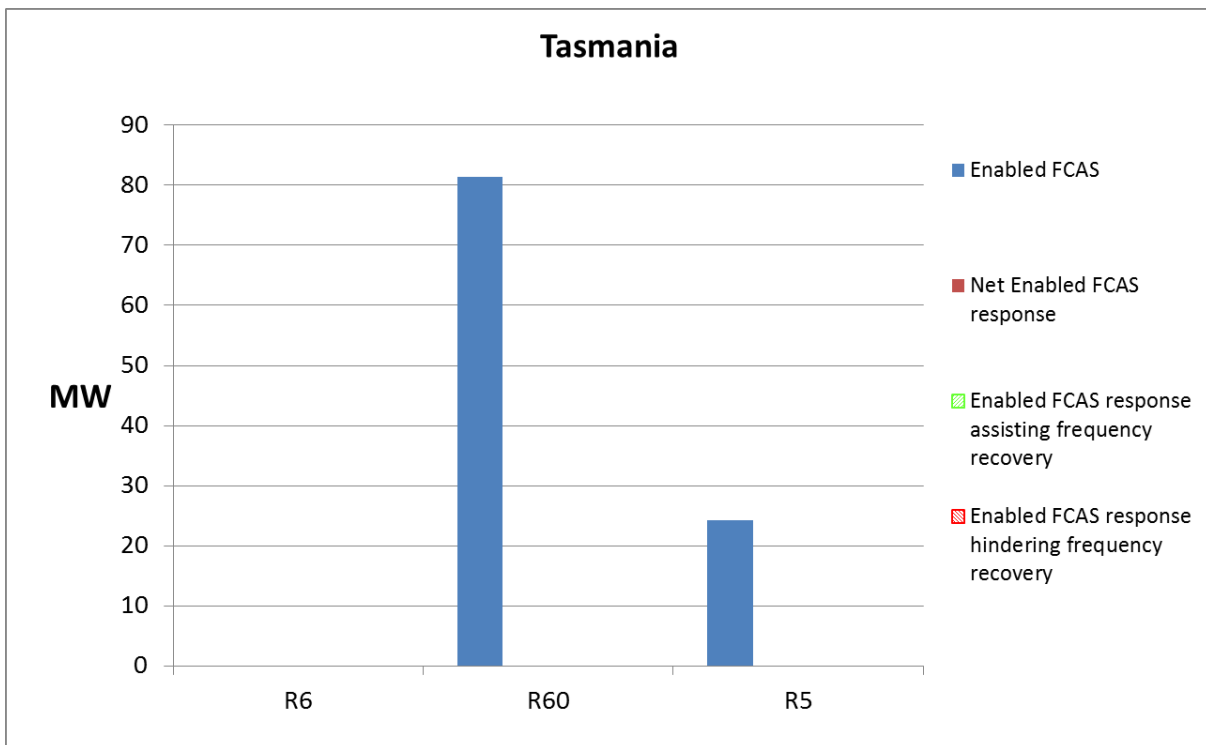


Figure 4: FCAS response to low frequency Normal Condition event in Tasmania 02/07/2012 13:11:36

### 6.3.2 Event: 05/07/2012 20:41:52

No contingency could be identified as the cause of the event on 05 July 2012 in Tasmania, Figure 5 shows that the Tasmania region frequency exceeded the Tasmania Frequency Operating Standards, and was outside the Normal Operating Frequency Band for 24 seconds. Frequency fell to a minimum 49.72 Hz in the Tasmanian Region. One Tasmanian generating unit was coming offline from 40 MW which contributed to the frequency excursion. Basslink was in service but not transmitting power during this event.

Compared to the enabled Slow Raise and Delayed Raise FCAS, nil amounts were delivered as shown in Figure 6. Nil amounts were delivered because the frequency returned to the Normal Operating Frequency Band in 24 seconds. The amount of Fast Raise services delivered was not calculated as high speed data was not requested for this event. Figure 5 also shows a deviation outside the Normal Operating Frequency Band at 2143 hours. This deviation is within the Normal Operating Frequency Excursion Band and is consistent with the Frequency Operating Standards.

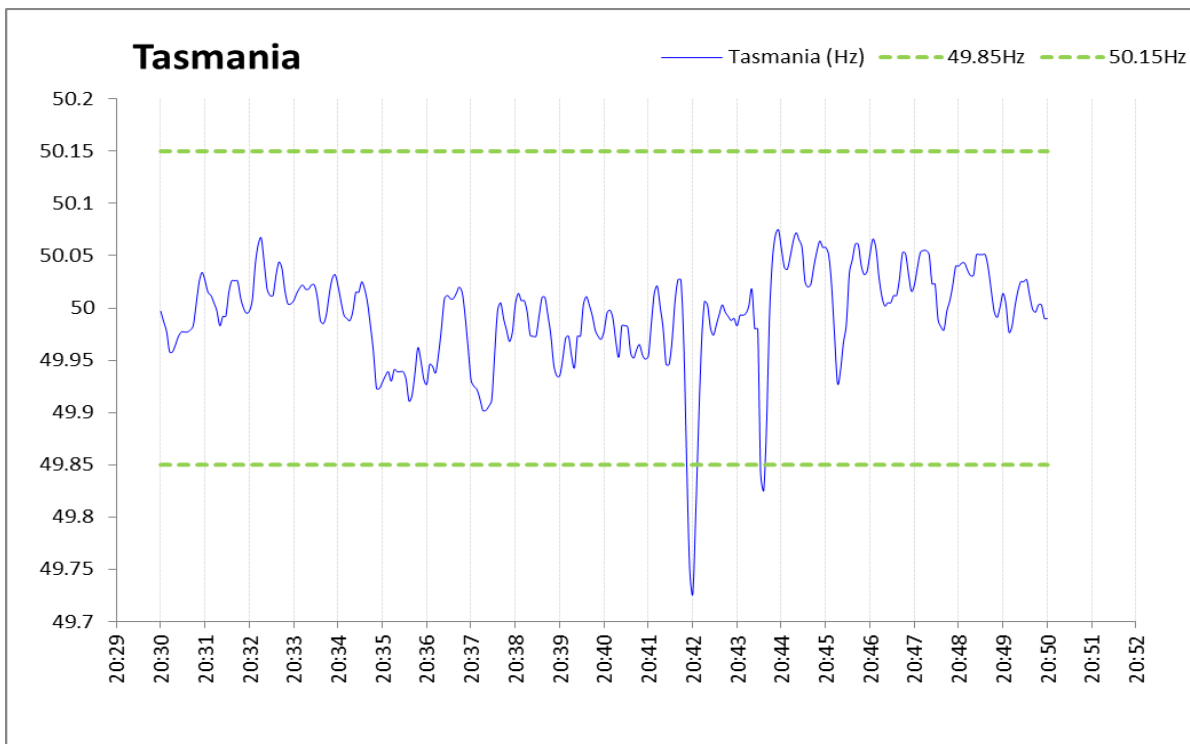


Figure 5: Low frequency Normal Condition event in Tasmania 05/07/2012 21:41:52

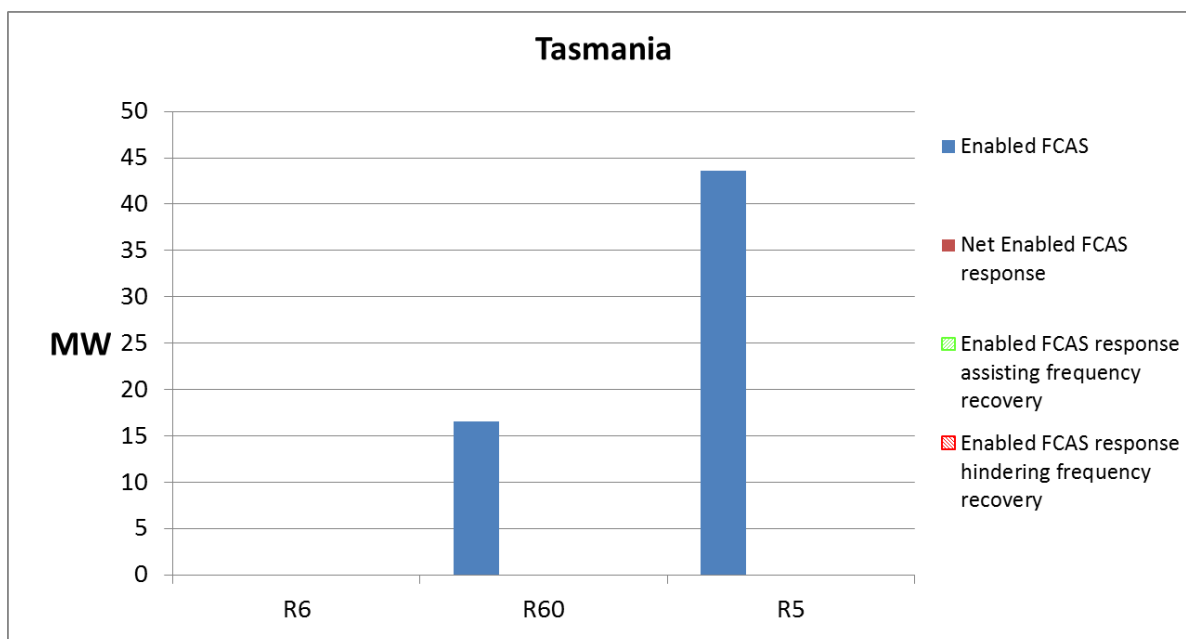


Figure 6: FCAS response to Normal Condition event in Tasmania 05/07/2012 21:41:52.

## 6.4 High frequency events in Tasmania

There was one high frequency event in Tasmania region during July 2012 that did not meet the Tasmania Frequency Operating Standard. This event is listed in Table 4.

Table 4: High frequency events in the Tasmania region resulting in frequency exceeding the Tasmania Frequency Operating Standards.

DATE	EVENT	MAX FREQUENCY (HZ)	TIME OUTSIDE NORMAL OPERATING BAND (49.85 HZ - 50.15 HZ)(SECONDS)
27/07/2012 07:21:40	No Condition causing the event was identified.	50.58	4

### 6.4.1 Event: 27/07/2012 07:21:40

No contingency could be identified as the cause of the low frequency event on 05 July 2012 in Tasmania, Figure 7 shows that the Tasmania region frequency exceeded the Tasmania Frequency Operating Standards, and was outside the Normal Operating Frequency Band for 4 seconds. Frequency rose to a maximum 50.58 Hz in the Tasmanian Region. One Tasmanian generating unit briefly synchronised to the system during the event to 5 MW, which contributed to the frequency excursion. Basslink was exporting approximately 220 MW to the Mainland during this event.

Compared to the enabled Slow Lower and Delayed Lower FCAS, nil amounts were delivered as shown in Figure 8. The amount of Fast Raise services delivered was not calculated as high speed data was not requested for this event.

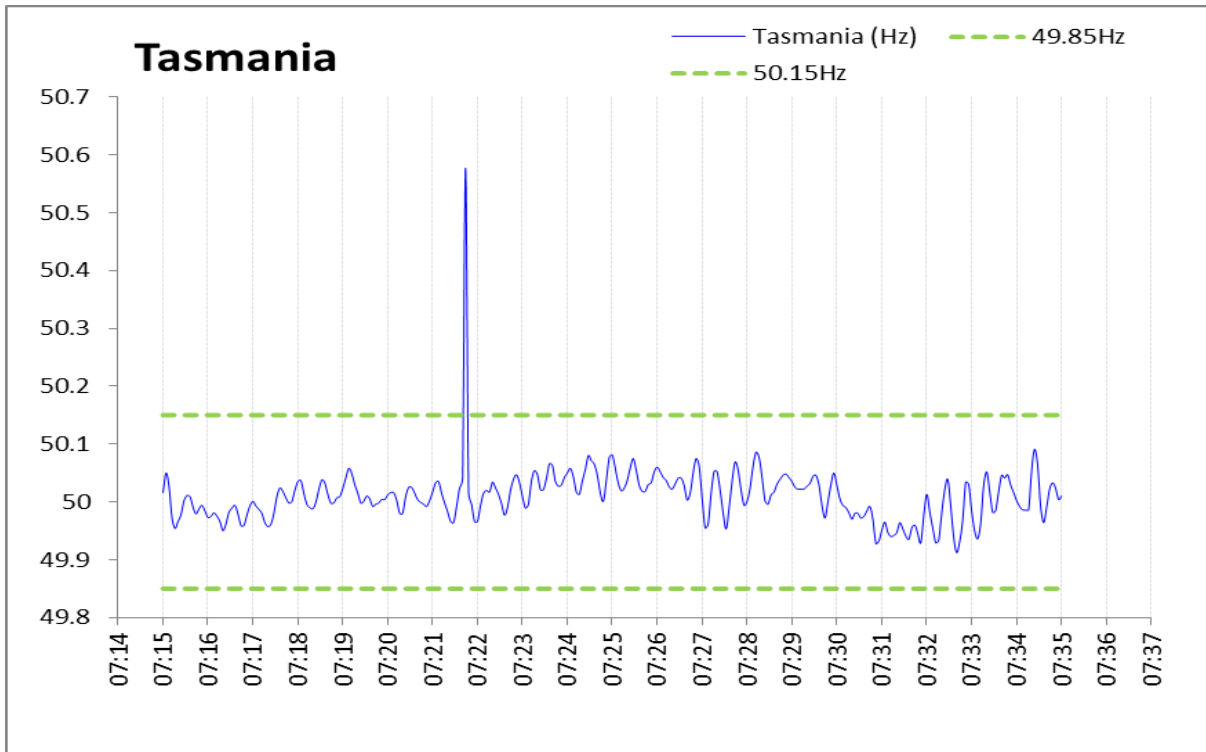


Figure 7: Low frequency Normal Condition event in Tasmania 27/07/2012 07:21:40.

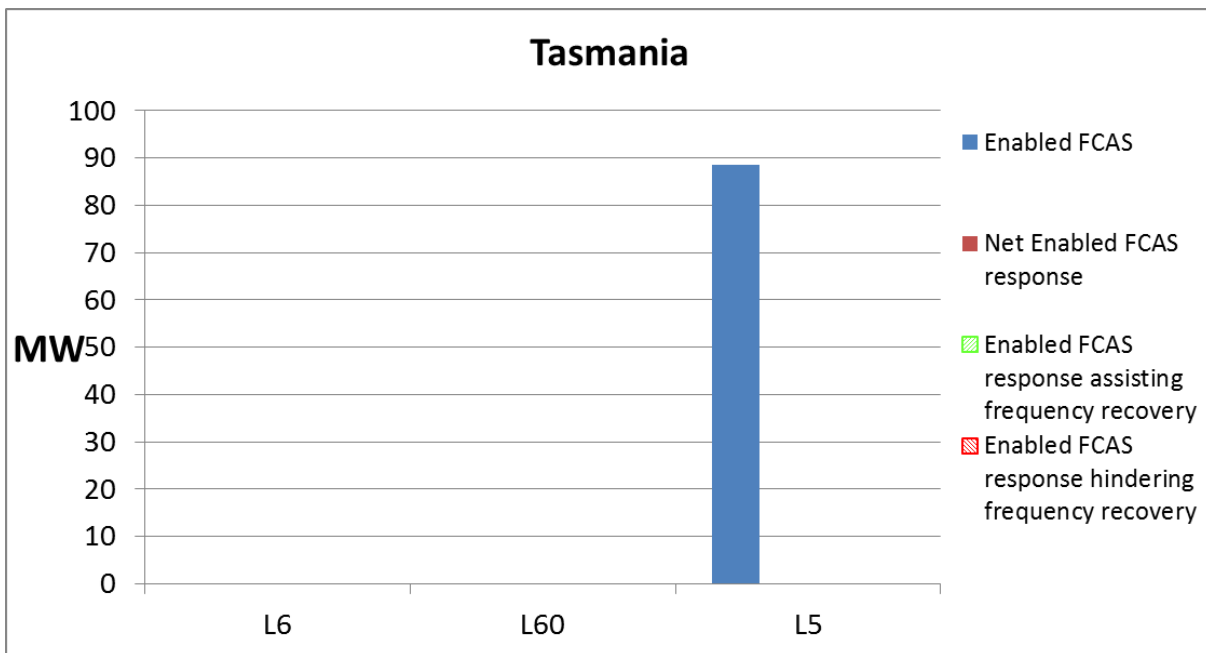


Figure 8: FCAS response to Normal Condition event in Tasmania 27/07/2012 07:21:40.

## 7 Accumulated time error

The Frequency Operating Standards require that the accumulated time error be maintained within the range  $\pm 5$  seconds in Mainland regions and  $\pm 15$  seconds in Tasmania. Constraints used to control accumulated time error, by varying the amount of Regulation FCAS enabled, are based upon measurements taken in Queensland, New South Wales and Tasmania. The range of accumulated time error recorded for these measurements in July 2012 is provided in Table 5.

Table 5: Accumulated time error measurements in July 2012.

VALUE	QLD	NSW	TAS
Highest positive time error (seconds)	2.58	2.58	4.30
Lowest negative time error (seconds)	-3.52	-3.64	-11.35