AEMC Reliability Panel

Tasmanian Frequency Operating Standard Review

Final Report

18 December 2008

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About the AEMC

The Council of Australian Governments, through its Ministerial Council on Energy, established the Australian Energy Market Commission (AEMC) in July 2005 to be the Rule maker for national energy markets. The AEMC is currently responsible for Rules and policy advice covering the National Electricity Market and elements of the natural gas markets. It is a statutory authority. Our key responsibilities are to consider Rule change proposals, conduct energy market reviews and provide policy advice to the Ministerial Council on Energy as requested, or on AEMC initiative.

About the AEMC Reliability Panel

The Panel is a specialist body within the AEMC and comprises industry and consumer representatives. It is responsible for monitoring, reviewing and reporting on the safety, security and reliability of the national electricity system and advising the AEMC in respect of such matters. The Panel's responsibilities are specified in section 38 of the NEL.

Disclaimer

Reliability Panel Members

Chairman

Ian C Woodward, Commissioner, Australian Energy Market Commission

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* Mark Grenning and Geoff Willis declared a potential conflict of interest in the Panel's review of the Tasmanian *frequency operating standards* and did not participate in the decision for the Panel's final report.

Contents

Abbreviations

Italicised terms in this report have the same meaning as in Chapter 10 of the National Electricity Rules.

2006 Review	Tasmanian reliability and frequency standards review
AEMC	Australian Energy Market Commission
AER	Australian Energy Regulator
AETV	Aurora Energy Tamar Valley
CCGT	Combined cycle gas turbine
CRA	Charles River Associates
Code	National Gas Code
Commission	see AEMC
FCAS	Frequency Control Ancillary Services (Market Ancillary Services in the Rules)
kV	Kilovolt
L6	Fast FCAS (6 second) lower service
MCE	Ministerial Council on Energy
MNSP	Market Network Service Provider
NECA	National Electricity Code Administrator
NEL	National Electricity Law
NEM	National Electricity Market
NEMMCO	National Electricity Market Management Company
NEMDE	NEMMCO Dispatch Engine
NEO	National Electricity Objective
OCGT	Open cycle gas turbine
OFGSS	Over frequency generator shedding scheme (also known as the OFGTS)
OFGTS	Over frequency generator tripping scheme (also known as the OFGSS)
Panel	Reliability Panel
R6	Fast FCAS (6 second) raise service
Rules	National Electricity Rules
SPS	System Protection Scheme (the Basslink SPS limits the size of the contingency)
SRMC	Short Run Marginal Cost
TNSP	Transmission Network Service Provider
Transend	Transend Networks Pty Ltd
TRNPP	Tasmanian Reliability and Network Planning Panel
TVPS	Tamar Valley Power Station (the Alinta 210 MW CCGT)
UFLSS	Under frequency load shedding scheme

Executive Summary

In February 2008 the Australian Energy Market Commission (AEMC) provided the Reliability Panel (Panel) with terms of reference requiring it to conduct a review of the Tasmanian *frequency operating standards*. The terms of reference require the Panel to conduct the review in accordance with section 38 of the National Electricity Law (NEL) using the consultation processes in clause 8.8.3 of the Rules.

The Panel must have regard to the national electricity objective,[1] which is set out in section 7 of the NEL, when it performs this review of the Tasmanian *frequency operating standards*.

The purpose of the *frequency operating standards* is to define the range of allowable frequencies for the electricity power system under different conditions, including normal operation and various contingencies. Equipment connected to the power system must be capable of operating within the frequency ranges specified in the *frequency operating standards*. NEMMCO is responsible for managing the frequency to meet the requirements of the *frequency operating standards*.

The purpose of this final report is to describe the Panel's changes to the Tasmanian *frequency operating standards* and the Panel's reasoning.

Review context

There has been an interest in diversifying the range of possible electricity generating technologies that can be connected in the Tasmanian region as this would increase the security and reliability of the energy supplies to Tasmania, as well as facilitate competition. However, the existing Tasmanian *frequency operating standards* are not as tight as those standards that apply on the NEM mainland and this has meant that some higher efficiency thermal generating units cannot meet the minimum access standards in terms of frequency ride through.[2] In particular, under the existing standards the frequency is able to be as low as 46 Hz, while many thermal generating units are required to trip at 47 Hz and can only operate below 48 Hz for limited periods. While this barrier to entry has been acknowledged by stakeholders, previous reviews of the Tasmanian *frequency operating standards* have not been able to economically or technically justify aligning, even partially, with the NEM mainland standards.

1 "The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to—
(a) price, quality, safety, reliability and security of supply of electricity; and
(b) the reliability, safety and security of the national electricity system."

2 The frequency ride through requirements are specified in schedule 5.2.5.3 of the Rules. This schedule operates in conjunction with the *frequency operating standards* that apply in the associated region.

Prior to Tasmania's entry into the NEM, annual reviews of the Tasmanian *frequency operating standards* were performed by the Tasmanian Reliability and Network Planning Panel (TRNPP). Following Tasmania joining the NEM in May 2005, the Panel acquired responsibility for the Tasmanian *frequency operating standards* and was required to perform a review within one year. In its 2006 review, the Panel determined that the existing Tasmanian *frequency operating standards* should continue to apply until NEMMCO has gained sufficient experience operating Basslink, and then, the Panel would again undertake a benefit cost assessment of tightening the standards at a future time. In February 2008 the AEMC provided the Panel with terms of reference for this follow up review. The Panel commenced this review in April 2008.

The Panel received submissions and supplementary submissions from a range of stakeholders and held a well attended stakeholder forum in Hobart on 6 June 2008. As required under the Rules, the Panel also sought NEMMCO's advice on the implications of changes to the standards, and associated matters, proposed by stakeholders. In addition, the AEMC engaged consultants CRA to assist the Panel by performing the economic and technical assessment of the various proposals it received.

Some stakeholders proposed tightening the Tasmanian *frequency operating standards* to allow higher efficiency thermal generators such as large industrial combined cycle gas turbines (CCGT) or cogeneration steam turbines to operate in Tasmania. Other stakeholders expressed concerns that tightening the frequency standards and allowing large generating units to operate would significantly increase the FCAS requirements for Tasmania. This may lead to very high costs and could impact on the operation of the Tasmanian power system, as well as inhibiting the development of wind generation projects.

The *frequency operating standards* determined by the Panel apply to all market participants once these standards are implemented. The Panel has published this final report on the standards in accordance with its AEMC terms of reference.

Assessment of changes to the Tasmanian frequency operating standards

The Tasmanian power system differs significantly from that on the NEM mainland in that it:

- is small in terms of the size of the load and installed generating capacity;
- has relatively large load, generator and network contingencies, as a proportion of the total system;
- is predominantly supplied by hydro generating units;
- can have a relatively low inertia, particularly when Tasmania is importing energy via Basslink at a time of low Tasmanian demand;

- experiences shortages of fast acting frequency control ancillary services (FCAS) because of the slow response of hydro generators to frequency disturbances; and

- is more susceptible to hydrological risks.

Importantly in this context any consideration to widening the future range of generation alternatives for Tasmania involves recognising the role of both frequency standards and the relative contingency size for which the frequency standards apply.

The Panel's analysis indicates that there is a need for new and diverse generation for the future security and reliability of the electricity supply in Tasmania. However, higher efficiency thermal generating units are unlikely to be able to connect to the Tasmanian network under the existing Tasmanian *frequency operating standards*. The Panel does note that some small and lower efficiency thermal plant may be available which could meet the existing standards, albeit with comparatively higher capital costs.

Therefore, the Panel has considered the range of proposals from stakeholders and performed an initial assessment of the five scenarios in the following table.

Summary of the Panel's Assessment

Possible Scenarios	A	B	C	D	E
Frequency Operating Standards	Leave unchanged	Minor changes plus mitigation	Tighten standards plus mitigation	Tighten standards	NEM mainland standards
Additional mitigation mechanisms	• None	• Limit contingency size • Trip additional load at 47 Hz when unit trips	• Limit contingency size • Consider FCAS cost recovery mechanisms	• None	• None
Benefits	• No additional FCAS costs	• No additional FCAS costs • No changes to existing UFLSS or Basslink frequency controller	• Opens wider options for future generator development • Excessive FCAS costs avoided	• Opens wider options for future generator development	• Consistency with NEM mainland standard
Costs	• Potential long run impacts from restrictions to the form of new generation developments to meet reliable supply	• High costs for additional loads • Reduced UFLSS effectiveness	• Small increase in R6 FCAS costs	• Significant increase in R6 FCAS requirements	• Very significant increase in R6 FCAS costs
Feasibility	• Yes, but future higher efficiency thermal generators unlikely	• Voltage stability issues • Additional loads need to be independent of the existing UFLSS and near the generating unit • Difficulties in applying to future projects	• Yes. Must specify how to mitigate contingency with a limit • Minor reduction in effectiveness of UFLSS under certain rare situations	• R6 FCAS costs very high • NEMMCO would need to intervene regularly	• Sufficient FCAS not available • NEMMCO would need to intervene regularly
National electricity objective	• Limits future development	• Higher UFLSS costs • Greater risks during under frequency events • Limits future development	• Allows for new generation development without substantial costs	• Higher FCAS costs • Greater intervention to maintain system security	• Excessive FCAS costs • Not possible to maintain system security

The Panel considers that scenario B is unlikely to be consistent with the national electricity objective because it would be expensive to implement, result in greater risks to supply during low frequency events, would limit future investment in higher efficiency thermal generating units and is likely to create voltage stability issues. The Panel also considers that scenarios D and E would not be likely to contribute to achieving the national electricity objective given the limits on existing fast raise FCAS availability in Tasmania. For example, tightening the standard without a generator contingency limit would increase the fast raise FCAS requirement from 95 MW to 307 MW[3]. However, scenarios D or E could become more attractive at some stage in the future if the availability of fast raise FCAS increases and the overall shape of the Tasmanian generation portfolio changes.

Therefore, the Panel is not proposing to pursue scenarios B, D and E as recommendations for the Tasmanian *frequency operating standards*. This left the Panel with the broad choice between leaving the standards unchanged (scenario A) or tightening the standards with a mechanism to mitigate the impact of the size of the largest generator contingency (scenario C).

Charles River Associates (CRA) performed a benefit cost assessment for the Panel's draft report that showed scenario C would be expected to deliver marginally greater benefits than the associated costs, when compared to the no change scenario A. This conclusion is based on:

- a high level assessment showing there are material risks to the security of the electricity supply in Tasmania under some plausible conditions including higher than expected load growth, continued low hydro inflows, a prolonged outage of Basslink, or loss of the ageing Bell Bay generating units;
- the most likely base load generating technology that could be built in Tasmania, at least in the near future, is CCGT gas, not withstanding the significant contribution of wind in the future development of the State's generating portfolio; and
- the benefits in terms of price impacts of allowing lower capital costs and higher efficiency thermal generating units such as large industrial CCGTs would be expected to exceed the increased FCAS costs associated with the tighter frequency standards.

CRA revised its analysis for the Panel's final report. This is published as an addendum to its original report.[4] This revised analysis addresses issues in submissions and includes some revised data. For its revised analysis, CRA adopted a cost based approach to assessing the benefits and costs, rather than the price based approach used in its original assessment. CRA's revised assessment confirmed that

3 NEMMCO advice to the Panel on 23 May 2008.

4 CRA's Supplementary Report on Benefit-Cost Analysis for Tasmanian Frequency Operating Standards.

scenario C would be expected to deliver marginally greater net benefits when compared to the no change scenario A.

Therefore, the Panel is adopting scenario C to tighten the Tasmanian *frequency operating standards* but prescribe a contingency limit. This is expected to lead to reduced electricity costs in Tasmania in the long-run by allowing more higher efficiency generating units to connect without imposing materially higher FCAS costs and significantly impacting wind farm penetration, provided the size of the largest generator contingency is limited. Appendix A contains the proposed final Tasmanian *frequency operating standards*.

Final Tasmanian frequency operating standards

In addition to increasing the allowable low frequency under extreme conditions from 46 Hz to 47 Hz, the Panel is making a number of other smaller changes to further align the standards towards the NEM mainland, including:

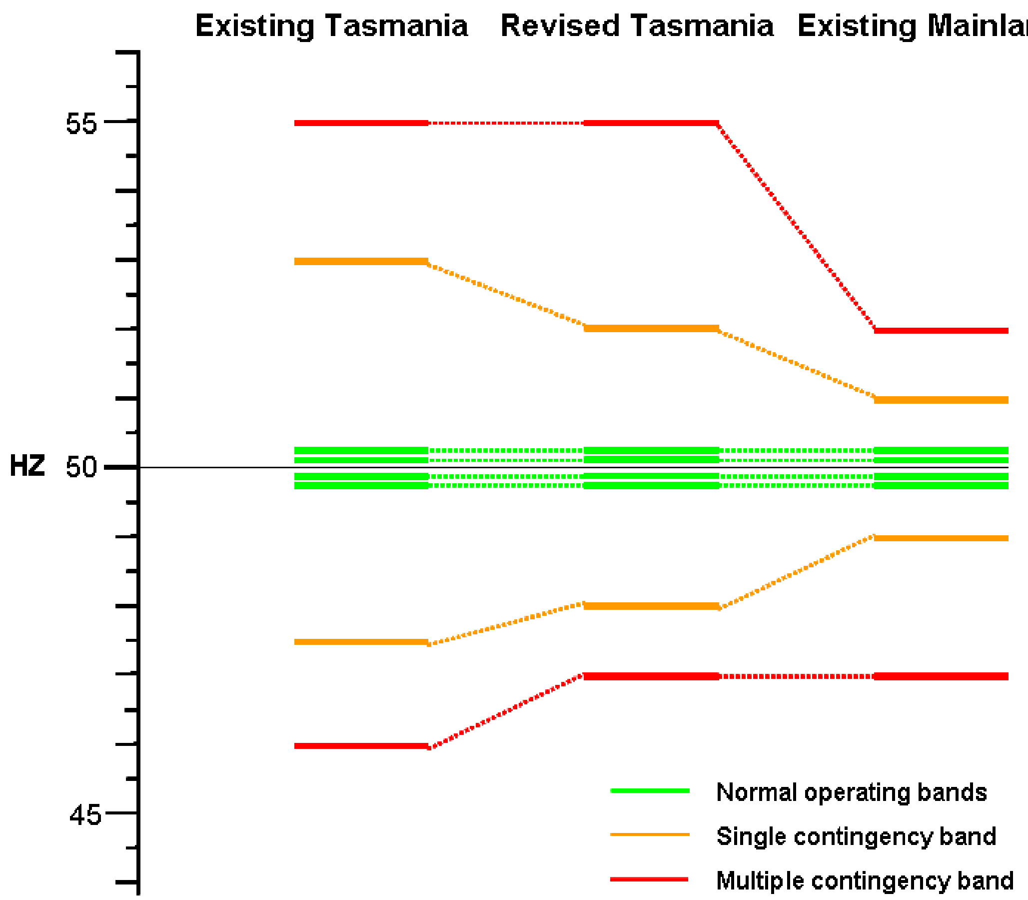
- increasing the lower limit of the load, generator and network event band to 48 Hz, thus requiring the under frequency load shedding scheme (UFLSS) to operate between 48 and 47 Hz;[5]
- aligning the upper limit of the *operational tolerance frequency band* for load, generator and network events to 52 Hz, thus allowing efficient thermal generating units to meet the minimum access standards;[6]
- aligning the recovery times for load, generator and network events to 10 minutes; and
- reducing the over frequency limit for extreme events under island conditions from 60 Hz to 55 Hz.

The figure below shows the extent that *extreme frequency excursion tolerance limits* (in red), the single contingency *operational frequency tolerance band* (in orange) and the *normal operating frequency bands* (in green) are revised from the existing levels to be closer to those that that apply on the NEM mainland. The revised *extreme frequency excursion tolerance limits* align with the NEM mainland for under frequencies, and the revised over frequency requirements are similar for the minimum access standards. Similarly, the *normal operating frequency bands* already align with the NEM mainland standards. The most significant difference between the revised Tasmanian standards and those for the NEM mainland are those that apply for single contingencies. This is because the relative supply of fast FCAS is significantly lower in Tasmania compared to the NEM mainland.

5 The existing UFLSS operates between 47.5 and 46 Hz. NEMMCO and Transend advise that the UFLSS can be modified to operate between 48 and 47 Hz with only a minor reduction in its performance.

6 Further details on the minimum access standards for over frequencies are discussed in chapter 5.

Comparison of the Tasmanian standards (existing and revised) with the NEM Mainland under normal conditions



Mitigating the generating unit contingency size

As discussed above, the feasibility of tightening the Tasmanian *frequency operating standards* at this stage depends on limiting the size of the generator contingency as the FCAS costs depend on both the *frequency operating standards* and the size of the largest contingency. This could be implemented using a constraint equation in the NEMMCO dispatch process. For example, where the capacity of a generating unit is larger than the largest allowable generator contingency, the associated generator could operate above the contingency limit by implementing an arrangement that is similar to the Basslink system protection scheme (SPS). That is, by automatically tripping contracted load whenever a new large generating unit trips such that the combined contingency size is limited. However, the ability of a large generating unit to operate up to its full capacity would not necessarily be restricted, provided that contracted load is available to be tripped to limit the size of the resulting contingency.

Form of the mechanism to limit the contingency size

The Panel considers that ideally the size of the contingency should be determined for each dispatch interval following an economic trade off between the benefits of the resulting generation and the costs of the associated FCAS. However, in the absence of this dynamic economic trade off, the Panel has accepted a fixed limit on the contingency size of 144 MW. This contingency size limit equals the existing maximum generator contingency in Tasmania and formed the basis of NEMMCO's advice.

In its draft report the Panel also considered a variable contingency size limit that depended on variables such as system load and Tasmanian inertia. While the Panel has not recommended this approach in its final report, it considers that this approach should be investigated further.

Including a limit on the generator contingency size in the frequency operating standards

The Panel may include a limit on the generator contingency within the Tasmanian *frequency operating standards* because such a limit is necessary for the Panel's final decision to be consistent with the national electricity objective. That is, a tightening of the Tasmanian *frequency operating standards* in the absence of a limit on the size of the generator contingency limit would cause economic efficiency costs that are likely to exceed the economic benefits. In addition, the absence of a contingency limit would likely lead to more frequent interventions by NEMMCO in order to maintain security of the Tasmanian power system. Therefore, without a limit on the contingency size would not be likely to contribute to achieving the national electricity objective.

Future review of the limit on generator contingency size

The Panel would consider reviewing the form of the generator contingency size limit, or its need, in the future following experience with the existing limits or if a new alternative arrangement is developed that efficiently trades off the economic FCAS costs against the contingency size. Such a change to the Tasmanian *frequency operating standards* would require a consultation in accordance with clause 8.8.3 of the Rules.

Recovering the costs of the increased FCAS requirements

While limiting the contingency size has the effect of significantly lowering the FCAS requirements and its associated costs, the changes to the Tasmanian *frequency operating standards* will themselves result in a small increase in the FCAS requirements, particularly for fast (six second) raise. For example, at a Tasmanian demand of 900 MW, an additional 31 MW[7] of fast raise FCAS is typically required if the lower limit of the single contingency *operational frequency tolerance band* is raised from the current 47.5 Hz to the revised value of 48 Hz.

7 Draft NEMMCO advice to the Panel, 23 May 2008.

Under the existing mechanisms many of the benefits of changing the standards would be captured by new higher efficiency thermal generating units while the costs of the additional FCAS would be recovered from all generators. The Panel notes that there is a potential for possible Rules changes from stakeholders who consider that a different cost allocation arrangement should apply.

Implementation – transitional arrangements

The Panel considers that all of the following issues need to be addressed before the revised Tasmanian *frequency operating standards* can take effect:

- the UFLSS needs to be redesigned and modified; and
- the OFGSS needs to be redesigned and modified; and
- the Basslink frequency controller needs to be modified; and
- the Basslink FCSPS needs to be modified; and
- new FCAS trapeziums need to be calculated and implemented for Tasmanian generating units.

Therefore, the Panel has determined that the revised Tasmanian *frequency operating standards* will take effect when the above issues have been addressed, and this should be completed by 31 December 2009. The Panel would consider extending this deadline if requested and following a public consultation process on the proposed later date in accordance with clause 8.8.3.

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1 Review context and process

1.1 Context of the Review

1.1.1 Purpose of the frequency operating standards

The purpose of the *frequency operating standards* is to define the range of allowable frequencies for the electricity power system under different conditions, including normal operation and various contingencies. Generator, network and end-user equipment must be capable of operating within the range of frequencies defined by the *frequency operating standards*, while NEMMCO is responsible for procuring sufficient ancillary services and ensuring that there are adequate emergency control systems to maintain the frequency within the ranges defined by the *frequency operating standards*.

1.1.2 Tasmanian entry into the NEM

General

Tasmania joined the National Electricity Market (NEM) in May 2005. Prior to Tasmania's entry into the NEM, the Tasmanian Reliability and Network Planning Panel (TRNPP) performed annual reviews of the Tasmanian *frequency operating standards*. The most recent review of the TRNPP was published in March 2006.[1]

In recent years, there have only been relatively minor changes to the Tasmanian *frequency operating standards*.

2006 Tasmanian Reliability and Frequency Operating Standards Review

Under clause 8.8.1(a)(2) of the Rules, the Panel of the AEMC is required to determine the reliability and power system *frequency operating standards* for the National Electricity Market (NEM). Tasmania joined the NEM in 2005 and, under clause 9.49.3 of the Rules, the Panel was required to determine reliability and frequency operating standards for Tasmania by the first anniversary of Tasmania joining the NEM (the transition date).

The Tasmanian reliability standard determined by the Panel took effect from when its determination was published and the interconnection date (as defined in clause

1 The TRNPP's determinations are available on the website of the Office of the Tasmanian Energy Regulator located at http://www.otter.tas.gov.au. The TRNPP's *frequency operating standards* determination was originally published on 14 February 2006 to apply from 20 February 2006. The TRNPP published a revised version of its determination on 2 March 2006. The Panel understands that this version rectified minor inconsistencies and that those changes did not affect the date from which the Tasmanian *frequency operating standards* applied (20 February 2006). For clarity, references to the TRNPP's determination are to the revised version.

9.49.1(b) of the Rules). Basslink was commissioned on 29 April 2006. Accordingly, this became the interconnection date. The Tasmanian *frequency operating standards* determined by the Panel applied from 30 May 2007.

In making its determination in relation to the Tasmanian *frequency operating standards*, the Panel was required under clause 9.49.4 of the Rules to have regard to the existing standards as determined by the TRNPP.

The Panel published its draft determination on the Tasmanian reliability and frequency operating standards for consultation on 24 March 2006. Submissions closed on 26 April 2006 and the Panel held a meeting open to NEM registered participants in relation to the draft determination in Hobart on Friday 21 April, 2006.

The Panel received submissions from the TRNPP, the Tasmanian Department of Infrastructure, Energy & Resources, Hydro Tasmania and Aurora Energy. The Panel considered the submissions, and the discussions at the meeting in Hobart, when finalising this determination on the Tasmanian reliability and frequency operating standards.

On 25 May 2006, the Panel published its final determination on the Tasmanian reliability and frequency standards review (2006 Review). The Panel reached the following conclusion in its 2006 Review:

- that a phased approach to determining the Tasmanian reliability and frequency operating standards was appropriate;

- that the Tasmanian *frequency operating standards* set out in the TRNPP's March 2006 determination would be adopted as the *frequency operating standards* that would apply in Tasmania from 30 May 2007;

- that the opportunities for further alignment of the Tasmanian *frequency operating standards* with the NEM mainland standards would be considered in an additional review to be undertaken with at least 12 months Basslink operational experience; and

- that the additional review following the 2006 Review would require:

  - a full cost benefit analysis of any proposed changes;

  - experience of the Tasmanian market once Basslink commenced its operation;

  - drawing on work to be undertaken by NEMMCO in relation to the Tasmanian automated frequency management schemes; and

  - being conducted in accordance with the principles under the Rules that applied to the 2006 Review.

1.2 Current review

1.2.1 The desire to consider alignment of the Tasmanian and NEM mainland standards

There has been an interest in diversifying the range of possible electricity generating technologies that can be connected in the Tasmanian region. This has been considered desirable as it would increase the security and reliability of the energy supplies to Tasmania as well as facilitate competition. However, the Tasmanian *frequency operating standards* are not as tight as the standards that apply on the NEM mainland. This means that higher efficiency thermal generating units cannot currently meet the minimum access standards in terms of the frequency ride through[2] requirements in the Rules and this has been a significant barrier to entry into the Tasmanian region for these types of generating units.

Therefore, in its review in 2006 the Panel indicated that this future review of the Tasmanian *frequency operating standards* would consider the economic benefits of allowing greater diversity and competition within the Tasmanian energy market against the costs of implementing any changes to the standards.

1.2.2 The desire to review the standards

The Tasmanian Minister[3] has indicated that the review of the Tasmanian *frequency operating standards* is important to the future development of the Tasmanian system. He indicated that Tasmania needs to replace the aged Bell Bay thermal plant, help rebuild the hydro energy storage position and help meeting the growing demand As a result, a review of the Tasmanian *frequency operating standards* needs to consider the need to bring on the most economic and efficient sources of new generation as well as to facilitate efficient market operations.

Aurora Energy[4] also considered this review of the Tasmanian *frequency operating standards* to be important. Aurora Energy identified the need to reduce barriers to new entry because of the record low hydro storage levels and to facilitate greater competition in the Tasmanian wholesale electricity market.

Alinta[5] and Gunns[6] have also expressed their support for the review of the Tasmanian *frequency operating standards*. In their submissions, Alinta and Gunns indicated that they are proposing to build new generating units that would not be able to connect under the existing Tasmanian *frequency operating standards*.

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2 The frequency ride through requirements are required in schedule 5.2.5.3 of the Rules. This schedule operates in conjunction with the *frequency operating standards* that apply in the associated region.

3 The Hon. David Llewellyn Minister of Parliament submission, 21 May 2008.

4 Aurora Energy submission, 23 May 2008.

5 Alinta submission, 24 April 2008.

6 Gunns submission, 23 May 2008.

1.2.3 Rules obligations

Clause 8.8.1(a)(2) of the Rules requires the Panel to:

> review and, on the advice of *NEMMCO*, determine the *power system security and reliability standards*;

The *power system security and reliability standards* include the frequency levels for the operation of the power system, which is specified in the *frequency operating standards*.

The Panel is conducting this review in accordance with clause 8.8.3 of the Rules and section 38 of the NEL.

The Panel must also have regard to the national electricity objective (NEO), which is set out in section 7 of the NEL, when it performs this review of the Tasmanian *frequency operating standards*.

1.2.4 Separate frequency operating standards for NEM mainland

In parallel to this Tasmanian *frequency operating standards* review, the Panel is also conducting a review of the *frequency operating standards* in the mainland of the NEM for periods of supply scarcity during load restoration. The Panel, on the advice of NEMMCO, is not considering changes to the existing arrangements during load restoration in Tasmania due to the increased risk of a cascading failure.

Further information on this review is on the AEMC website.[7]

1.2.5 The AEMC terms of reference

In February 2008 the AEMC provided terms of reference to the Panel requesting it, in accordance with section 38 of the NEL and clause 8.8.3 of the Rules, to undertake a review of the *frequency operating standards* for Tasmania. The AEMC considered that this review is likely to have important implications for NEM stakeholders. The AEMC requested that the Panel plan to involve stakeholders by seeking submissions and holding forums on the Tasmanian *frequency operating standards*. The AEMC requested that the Panel should aim to complete its review by 31 December 2008.

The AEMC terms of reference are reproduced in chapter 3.

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7 Further information on the Panel's review of the NEM mainland *frequency operating standards* during times of scarcity is available at http://www.aemc.gov.au/electricity.php?r=20080327.122851.

3 Assessment criteria for the Review

This chapter presents an overview of the assessment criteria for the Panel's review of the Tasmanian *frequency operating standards*.

3.1 National electricity objective and terms of Reference

As discussed in Chapter 1 of this report, when the Panel assessed changes to the Tasmanian *frequency operating standards*, in this review it considered the extent that the changes would be likely to contribute to achieving the NEO.

3.1.1 The national electricity objective

The NEO is set out in section 7 of the NEL:[16]

> The objective of this Law is to promote efficient investment in, and efficient operation and use of, electricity services for the long term interests of consumers of electricity with respect to—
>
> (a) price, quality, safety, reliability and security of supply of electricity; and
>
> (b) the reliability, safety and security of the national electricity system.

3.1.2 Terms of reference

The terms of reference are as follows:

> **Reliability Panel**
> **Review of Frequency Operating Standards for Tasmania**
> **AEMC Terms of Reference (18 March 2008)**
>
> **Introduction**
>
> As part of its Comprehensive Reliability Review, the Commission published on 25 May 2006 the final determination by the Reliability Panel (Panel) on the *frequency operating standards* applicable in Tasmania from 29 May 2007. In this final determination, the Panel foreshadowed that it would revisit the Tasmanian *frequency operating standards* after at least 12 months operation of Basslink and has included this in its work program for 2008.

16 National Electricity (South Australia) Act 1996.

Scope of the Frequency Operating Standards Review

Clause 8.8.1(a)(2) of the National Electricity Rules requires the Reliability Panel to:

> review and, on the advice of *NEMMCO,* determine the *power system security and reliability standards*;

The *power system security and reliability standards* sets out the frequency levels for the operation of the power system, which is specified in the *frequency operating standards*.

This review will be conducted in accordance with clause 8.8.3 of the National Electricity Rules.

Therefore, the AEMC requests the Panel, in accordance with section 38 of the NEL and clause 8.8.3 of the National Electricity Rules, to undertake a review of the *frequency operating standards* for Tasmania.

Process

This review is likely to have important implications for NEM stakeholders. Consistent with its philosophy of engaging with those parties, the AEMC requests the Panel to plan to involve stakeholders by seeking submissions and holding forums on the Tasmanian *frequency operating standards*.

Timing

Recognising the extensive work program within the Panel, the Panel should aim to complete its review by 31 December 2008.

3.2 Stakeholder views

The Panel received a large number of submissions, supplementary submissions and presentations. A list of the submissions provided to the Panel is provided in Appendix B of this report.

A summary of the issues raised in these submissions is provided in Appendix C of this report.

2 Existing frequency control arrangements in Tasmania

2.1 Purpose of the Tasmanian frequency operating standards

The Rules define the *frequency operating standards* as "the standards which specify the *frequency* levels for the operation of the *power system* as set out in the *power system security and reliability standards*."[8]

The purpose of *frequency operating standards* are to:

1. give the system operator – in most cases NEMMCO – set limits in which it has an obligation to maintain operation of the power system; and

2. place a requirement on plant and network elements of the power system to meet the *frequency operating standards*.

2.2 Existing Tasmanian frequency operating standards

The *frequency operating standards* in Tasmania have remained relatively unchanged for many years due mainly to the unique generating characteristics of the Tasmanian power system which is predominantly hydro based with limited thermal generating capacity. The *frequency operating standards* that currently apply in Tasmania came into effect on 30 May 2007, as a result of the Reliability Panel's determination in relation to "Tasmanian Reliability and Frequency Standards".[9] At the time of its review in April 2006, the Panel adopted the *frequency operating standards* determined by the TRNPP with amendments from the Panel through consultation with NEMMCO.[10] The following section gives a summary of the current Tasmanian *frequency operating standards*.

For the purposes of the Rules, the *frequency operating standards*, forming part of the *power system security and reliability standards*, that apply in Tasmania are summarised in the following Table 2.1 and Table 2.2.[11]

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8 NER, Chapter 10 definitions. Italicised words are also defined in Chapter 10 of the Rules.

9 For more information see, http://www.aemc.gov.au/electricity.php?r=20060525.144027.

10 The TRNPP determinations are available on the website of the Office of the Tasmanian Energy Regulator located at http://www.otter.tas.gov.au. The TRNPP's frequency standards determination was originally published on 14 February 2006 to apply from 20 February 2006. The TRNPP published a revised version of its determination on 2 March 2006. The (National) Panel understands that this version rectified minor error and inconsistencies and that those changes did not affect the date from which the standards applied (20 February 2006). For clarity, references to the TRNPP's determination are to the revised version.

11 For more information see, AEMC Panel Review 2006, Tasmanian Reliability and Frequency Standards, 28 May 2006, Sydney, P.p 17-19.

Table 2.1 – Existing *Frequency operating standards* for any part of the Tasmanian power system

CONDITION	CONTAINMENT	STABILISATION	RECOVERY
Accumulated time error	15 seconds		
No contingency event or load event	49.75 to 50.25 Hz, 49.85 to 50.15 Hz, 99% of the time	49.85 to 50.15 Hz within 5 minutes	
Load event	49.0 to 51.0 Hz	49.85 to 50.15 Hz within 10 minutes	
Generation event	47.5 to 51.0 Hz	49.85 to 50.15 Hz within 5 minutes	
Network event	47.5 to 53.0 Hz	49.0 to 51.0 Hz within 1 minute	49.85 to 50.15 Hz within 5 minutes
Separation event	46 to 55 Hz	47.5 to 51.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes
Multiple contingency event	46 to 55 Hz	47.5 to 51.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes

Table 2.2 – Existing *Frequency operating standards* that apply to an island within the Tasmanian power system

CONDITION	CONTAINMENT	STABILISATION AND RECOVERY	
No contingency event, or load event	49.0 to 51.0 Hz		
Generation event or network event	47.5 to 53.0 Hz (Note)	49.0 to 51.0 Hz within 5 minutes	
Load event	47.5 to 53.0 Hz (Note)	49.0 to 51.0 Hz within 10 minutes	
The separation event that formed the island	46 to 60 Hz	47.5 to 53.0 Hz within 2 minutes	49.0 to 51.0 Hz within 10 minutes
Multiple contingency event including a further separation event	46 to 60 Hz	47.5 to 53.0 Hz within 2 minutes	49.0 to 51.0 Hz within 10 minutes

Note Where it is not feasible to schedule sufficient frequency control ancillary service to limit frequency excursions to within this range, operation of the UFLSS or OFGSS is acceptable on the occurrence of a further contingency event.

For the purpose of these *frequency operating standards* and the Rules, a term shown in column 1 of the Table 2.3 has the corresponding range shown in column 3 of the table for an island and has the corresponding range shown in column 2 of the Table otherwise.

Table 2.3 – Existing Frequency inclusion bands for normal and island operation

Term	Normal range (Hz)	Island range (Hz)
normal operating frequency band	49.85 to 50.15	49.0 to 51.0
normal operating frequency excursion band	49.75 to 50.25	49.0 to 51.0
operational frequency tolerance band	47.5 to 53.0	47.5 to 53.0
extreme frequency excursion tolerance limit	46.0 to 55.0	46.0 to 60.0

2.3 Frequency control mechanisms

2.3.1 Frequency Control Ancillary Services (FCAS)

FCAS, referred to as Market Ancillary Services in the Rules, are required to maintain appropriate levels of contingency reserve and regulating reserve and can be classified as belonging to one of the following categories:

- *regulation services* are required to maintain frequency within the *frequency operating standards* during typical load and generation variations within a 5-minute dispatch interval; and

- six contingency services (defined below) are required to ensure that the frequency remains within the *frequency operating standards*, following credible contingency events as established by the Panel.

The system requirements for each FCAS service are forecast in advance. Pursuant to clause 3.13.4A of the Rules, NEMMCO publishes weekly forecasts of the requirements for each type of *market ancillary service* for each *region* for the following week.

The *frequency operating standards* for containment, stabilisation and recovery (as shown in Table 2.1 and Table 2.2 above) determine the required amounts of the different FCAS categories. Following a contingency, FCAS are used as follows:[12]

- fast raise and lower FCAS are used for controlling frequency to the containment band;

- slow raise and lower FCAS are used for controlling frequency to the stabilisation band; and

[12] For more information see: NEMMCO operating procedure – Frequency Control Ancillary Services, Document Number SO_OP3708A, pp. 6-8.

- delayed raise and lower FCAS are used for controlling frequency to the recovery band.

In the absence of a contingency event requiring large deviation contingency services, the regulating services are the primary frequency control services utilised.

Regulating service requirements

Minor variations in frequency around 50 Hz occur continually as a result of normal fluctuations in consumer demand and generating unit performance.

NEMMCO's dispatch engine (NEMDE) uses forecast demand and establishes a linear path for generating units to follow for each five-minute dispatch interval. However, consumer demand does not vary linearly between dispatch intervals, and the imbalance between generation and demand causes the frequency to vary (even in the absence of contingency events). The regulating raise and lower FCAS are used to correct such frequency variations within each five-minute dispatch interval.

Contingency Service Requirements

The requirements for contingency services are a function of the largest generation output or load blocks on the power system, as well as the system inertia. In most instances, over a dispatch interval the largest generation and load blocks on the power system will be relatively constant, and so the contingency service requirement becomes a simple function of the system demand.

The requirement for FCAS can generally be distributed globally. That is NEMMCO will source the requirement for a service from all interconnected regions in a co-optimised manner using NEMDE. However, for the case of the Tasmanian region, which is only linked to the NEM mainland via Basslink, NEMMCO needs to source a portion of the FCAS requirements locally within the Tasmanian region, which is currently predominantly provided by Hydro Tasmanian generators. Basslink can also transfer FCAS from the mainland, although there are restrictions on what can be provided by Basslink depending on the margin between its transfer and the transfer limits.

Basslink and FCAS transfer

Basslink is a high voltage direct current (HVDC) interconnector between the States of Victoria and Tasmania. The interconnector is asynchronous, meaning that the phase and frequency of the alternating current (AC) in both States can be different. The limits of Basslink are 630 MW when exporting (Tasmania to Victoria, measured at the Tasmanian convertor terminal) and 500 MW when importing (Victoria to Tasmania, measured at the Victorian convertor terminal); however, due to the convertors on the system there is a "no-go" zone between -50 and +50 MW.[13]

The Basslink frequency controller system protection scheme (FCSPS) limits the size of a Basslink contingency to 144 MW under import (equivalent to the largest contingency currently in Tasmania) and 200 MW under export. The FCSPS automatically sheds load or generation in the event that Basslink trips, with the required amounts to be shed calculated automatically and dynamically.

Furthermore, the Basslink frequency controller modulates flow across the interconnector to level out frequency disturbances between the NEM mainland and Tasmania. This has the effect of allowing the transfer of FCAS between both sides of the interconnector and significantly smoothes frequency deviations in Tasmania. The optimal dispatch of energy and FCAS over Basslink is determined by NEMDE, based on energy and FCAS bids and offers. However, FCAS transfer is limited by the margins between actual transfer and transfer limits – being maximum export, maximum import and the no-go zone (± 50 MW).

2.3.2 Under frequency load shedding scheme (UFLSS)

The under frequency load shedding scheme (UFLSS) is an emergency control system that automatically sheds system load during the low frequency periods that accompany multiple supply contingencies such as a series of generating unit trips, possibly including the tripping of Basslink.

The Tasmanian UFLSS currently includes seven load blocks that are available for tripping in the frequency range 47.5 Hz to 46.0 Hz, where 46 Hz is presently the bottom *extreme frequency excursion tolerance limit*. The Tasmanian UFLSS has been designed to maintain the system frequency above 46.5 Hz.

2.3.3 Over frequency generator shedding scheme (OFGSS)

The over frequency generator shedding scheme (OFGSS) is an emergency control system that automatically sheds generating units during the high frequency periods that accompany multiple supply contingencies such as a series of load trips, possibly including the tripping of Basslink.

The main requirement of the OFGSS is to maintain frequency should a separation (Island operation) occur between north and south Tasmania as a result of the tripping of transmission circuits. The scheme only trips generation, so it will operate on whichever area was exporting at the time of the trip, to maintain potential high frequencies within the Tasmanian frequency standard for island formation and operation.[14]

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13 For further information on the technical capabilities of Basslink see, Basslink submission and AEMC 2007, Dispatch of Scheduled Network Service, Rule Determination, 16 August 2007, Sydney.

14 http://nemmco.com.au/powersystemops/so_op3151v013.pdf

The OFGSS operates in parallel with the Tasmanian special protection schemes and has become a backup for the FCSPS since Basslink commenced operation in May 2006 to cover its partial or complete failure under export conditions.[15]

2.3.4 Island operation

Island operation occurs when a part of the Tasmanian power system that includes scheduled generation, networks and load, loses all of its network connections with other parts of the power system. During contingencies of this nature, the UFLSS and OFGSS schemes are instrumental in managing frequency deviations and bringing frequencies back to the normal operating band as quickly as possible.

15 Transend submission, p 6.

4 Economic assessment of options

4.1 Broad overview of the scenarios proposed by stakeholders

The Panel considered the range of scenarios that were proposed by stakeholders and compared them against making no changes to the Tasmanian *frequency operating standards* or any other associated arrangements. From this range, the Panel then identified those scenarios where it would perform a more comprehensive benefit cost assessment. Other stakeholders such as Transend and Hydro Tasmania also recommended a number of more detailed amendments that have the potential to improve the operation of the standards. These changes are discussed in chapter 5 of this report.

Importantly in this context, any consideration of widening the future range of generation alternatives for Tasmania involves recognising the role of both frequency standards and the relative contingency size for which the *frequency operating standards* apply.

The Panel considered the following scenarios that range from no change to complete alignment with the NEM mainland *frequency operating standards*:

A no change to the existing arrangements;

B minor changes to the Tasmanian *frequency operating standards* with mitigation to allow higher efficiency generating units to operate;

C tightening the Tasmanian *frequency operating standards* but with mitigation to limit the size of the largest contingency;

D tightening the Tasmanian *frequency operating standards* but without mitigation; and

E complete alignment of the Tasmanian frequency operating standards with the equivalent NEM mainland frequency operating standards.

4.2 Summary of benefits and costs for each scenario

4.2.1 Scenario A: No change to the existing arrangements

Any change to the existing Tasmanian *frequency operating standards* and associated arrangements needs to be compared to the base case of no change. Under this option:

- the Tasmanian *frequency operating standards* would not be changed; and
- there would be no need to make changes to the existing UFLSS, OGFSS, Basslink SPS and the Basslink frequency controller.

However, higher efficiency thermal generating units, such as industrial CCGTs, would not likely to be able to meet the minimum access standards as they currently apply in Tasmania.

This scenario is not consistent with the long term objective of introducing greater diversity of generating technologies into Tasmania.

4.2.2 Scenario B: Minimal change to the frequency operating standards with mitigation

Tightening the Tasmanian *frequency operating standards* and allowing higher efficiency thermal generating units to operate is likely to cause FCAS shortages, with associated high prices and possible interventions. It would also require changes to many of the existing frequency control schemes in Tasmania.

Therefore, Hydro Tasmania proposed a set of arrangements that would allow a new higher efficiency generating unit to connect in Tasmania without the need for tightening the under frequency aspects of the Tasmanian *frequency operating standards*. The aim of these arrangements is to avoid the need to find large quantities of FCAS and make changes to many of the existing Tasmanian frequency control schemes. The arrangements proposed by Hydro Tasmania are to:[17]

- limit the size of the contingency caused by the Tamar Valley Power Station (TVPS) tripping to 140 MW by requiring the generator to contract with 70 MW of load to be also tripped;
- allow the TVPS to trip at 47 Hz, but require additional load equal to the size of the generating unit to be included in the UFLSS, which would also be set to trip at 47 Hz to leave the energy balance no worse off; and
- allow the TVPS to participate in the OFGSS, thus allowing it to trip for frequencies above 52 Hz.

The arrangements proposed by Hydro Tasmania have the benefits of not requiring changes to the Tasmanian *frequency operating standards* and the associated issues with FCAS and the need to redesign some existing Tasmanian frequency control schemes. However, advice from NEMMCO and Transend identified some significant implementation issues with these arrangements. In particular:[18]

- the tripping of up to 210 MW of load in addition to the existing 60% of load that participates in the Tasmanian UFLSS during a multiple contingency event is likely to cause voltage instability, thus reducing the effectiveness of the UFLSS;
- the difficulty in finding, and the high associated costs, of the additional loads to be included in the UFLSS;

[17] Hydro Tasmania's submission on the draft report.

[18] NEMMCO advice and Transend submission on the draft report.

- the new higher efficiency thermal generating unit would not meet the minimum access standards for low frequency continuous operation; and
- it would be virtually impossible to connect any similar generating units in the future.

Operation of the UFLSS

The primary purpose of the Tasmanian UFLSS is to progressively disconnect large blocks of load in emergency low frequency conditions in an attempt for the remaining generation to recover the frequency. The existing scheme has been designed to be able to operate under a set of plausible non-credible contingencies that have been agreed with NEMMCO. It is acknowledged that no scheme can successfully manage every set of extreme simultaneous contingencies. However, the submission from Transend identified a number of possible scenarios where allowing a large generating unit and additional load to trip at 47 Hz is likely to cause voltage instability, which could then lead to an extensive blackout of the system.

Transend and NEMMCO also indicated that it may be very difficult to identify a further 210 MW of load that could be shed, given that the load could not already be included in the existing UFLSS or Basslink special protection scheme (SPS).[19] Transend indicated that additional load would need to be made available from a large number of small feeders, each with a peak rating less than 10 MW, at an under frequency relay cost of approximately $200,000 per feeder, meaning that the cost of the under frequency relays could easily be more than $16m.[20] Transend also indicated that it may be difficult to find the additional load while still being able to discriminate with the supply to critical loads (such as hospitals and emergency services). This would especially be the case if all the associated loads need to be in the vicinity of the new generating unit to minimise the risk of overloading the network. However, Hydro Tasmania suggested that the loads used to limit a generator contingency size could also be the same loads used in the Basslink SPS, as the loss of a large generating unit or the loss of Basslink are independent credible contingencies. The Panel agrees that this might be correct in principle, but a load may be unwilling to participate in too many load shedding schemes as this will increase the frequency at which they are shed.

While severe under frequency events are rare, the Panel considers that a significant reduction in the effectiveness of the UFLSS would not be in the long term interests of consumers as the associated economic costs and social impacts would be too high. The Panel also considers that the arrangements proposed by Hydro Tasmania would not be good regulatory practice as they only apply to the connection of a single

19 For the arrangement to be effective the full 210 MW of load would need to be available at 47 Hz and would, therefore, need to be independent of the Basslink SPS as a severe under frequency would be likely to involve a Basslink trip, and hence the SPS would have already operated.

20 The $16m is based on each feeder having a peak capacity of 5 MW, but only being able to reliably provide half this load at times of light load. This is also assuming that all the higher capacity feeders in the vicinity of the TVPS have already been included in the existing UFLSS.

higher efficiency generating unit and could not be readily applied to new generating units in the future.

Therefore, the Panel did not consider the arrangements proposed by Hydro Tasmania further in its assessment.

4.2.3 Scenario C: Changes to tighten the frequency operating standards with mitigation of generator contingency size

The Tasmanian *frequency operating standards* currently provide a barrier to the entry of higher efficiency thermal generating units, such as industrial CCGTs. In particular, such generating units generally must trip for frequencies below approximately 47 Hz, while the existing standards allow frequencies down to 46 Hz under extreme system conditions.

Therefore, a number of stakeholders including Alinta and Gunns have proposed tightening aspects of the Tasmanian *frequency operating standards*. Under this option:

- tighten the lower limit of the *operational frequency tolerance band* from 47.5 Hz to 48 Hz;
- tighten the lower limit of the *extreme frequency excursion tolerance limit* from 46 Hz to 47 Hz;
- align the upper limit of the *operational frequency tolerance band* to 52 Hz;
- redesign the existing UFLSS, OGFSS and the Basslink frequency controller to operate correctly to the new standard and co-ordinate correctly with other control systems such as the Basslink SPS; and
- industrial CCGT generating units would be expected to be able to meet the minimum access standards as they apply in Tasmania.

However, the advice from NEMMCO, which has been reinforced by many stakeholder submissions including Transend and Hydro Tasmania, is that simply tightening the Tasmanian *frequency operating standards*, thus allowing a new large higher efficiency thermal generating unit to connect and operate, would require dramatically more FCAS, particularly the six second FCAS raise service (R6). This increase in FCAS requirements would be likely to lead to:

- very high FCAS prices under many system conditions;
- significant limitations to the dispatch of energy across Basslink; and
- FCAS shortages under many conditions that could lead to NEMMCO constraining the dispatch in Tasmania.

The NEMMCO advice indicated that, in the case of a new 210 MW generating unit, most of this additional FCAS is due to the increase in the maximum generator contingency from the existing 144 MW. For example at system load of 900 MW, the NEMMCO advice indicated that typical FCAS requirements would be:[21]

Tasmanian *frequency operating standards*	Contingency size	R6 requirement
existing	144 MW	95 MW
tighten	210 MW	307 MW
tighten (with mitigation)	144 MW	126 MW

Under the typical light load conditions considered by NEMMCO, simply tightening the standard would increase the R6 requirement by 212 MW but tightening the standard in the presence of a mechanism to limit the generator contingency size to the existing 144 MW limits the increase in the R6 requirement to 31 MW. The FCAS requirements at higher loads are less dramatic and reduce as the system inertia increases, while the FCAS availability increases with the generally higher levels of generation running.

The Panel decided that this scenario – where the Tasmanian *frequency operating standards* are tightened but there is a mechanism to limit the size of the largest contingency – should be included in its full benefit cost assessment.

The Panel discusses how a mechanism to limit the size of the largest contingency could be implemented in section 4.4 below.

4.2.4 Scenario D: Changes to tighten the standards

The Panel considered the scenario of simply tightening the Tasmanian *frequency operating standards*, as proposed by Alinta and Gunns. However, as discussed above, the advice from NEMMCO and others is that this would require dramatically more FCAS, particularly the R6 service, and that this increase is mainly due to the increase in contingency size associated with a large new generating unit.

Therefore, the Panel considers that this scenario (simply tightening the Tasmanian *frequency operating standards* and allowing higher efficient generating units to connect without a contingency size limit) would be unlikely to advance the NEO. This is because the FCAS costs would be a significant cost in the Tasmanian region. The analysis described in section 4.3.3 shows that these costs would be higher than those for scenario C, without any material benefits over that scenario.

4.2.5 Scenario E: Complete alignment with the NEM mainland frequency operating standards

Aligning the Tasmanian *frequency operating standards* with those that apply on the NEM mainland would be significantly more difficult, and costly, than scenario D due to the very large quantities of contingency FCAS that would be required. Such large

21 NEMMCO advice to the Panel.

quantities of FCAS are unlikely to be available at a reasonable cost in Tasmania for the foreseeable future. Therefore, the Panel did not consider aligning the Tasmanian *frequency operating standards* with those of the NEM mainland as appropriate.

4.3 Benefit cost assessment of Scenarios A and C

The Panel engaged Charles River Associates (CRA) to assist its review of the Tasmanian *frequency operating standards*, in particular the benefit cost assessment of the scenarios considered by the Panel. CRA's initial report was published as an accompanying document to the Panel's draft report.

CRA updated its report and this is published as an accompanying document to the for the Panel's final report.[22]

4.3.1 Scenarios

The Panel notes that the following matters were relevant in its detailed benefit cost assessment of scenarios A and C.

Scenario A (no change) is characterised by:

- no change to the existing arrangements, including no change to the Tasmanian *frequency operating standards*; and
- only generating units that comply with the existing standards would meet the minimum access standards.

Scenario C (tightening the standards with mitigation) is characterised by:

- the opportunity for higher efficiency thermal generating units to be deployed that would be expected to be able to meet the minimum access standards as they apply in Tasmania by tightening the under and over frequency contingency bands and limits;
- modifying the existing UFLSS, OGFSS and the Basslink frequency controller to operate correctly with the amended standard and coordinate correctly with other control systems such as the Basslink SPS;
- a mechanism to mitigate the impact of the increase in contingency size, by including an explicit limit; and
- an increase in the FCAS requirements.

[22] CRA's Supplementary Report on Benefit-Cost analysis for Tasmanian Frequency Operating Standards.

4.3.2 Tasmanian energy outlook

Several stakeholders commented on the long term sustainability of the Tasmanian electricity supply in Tasmania. The CRA analysis indicates that on the basis of high level analysis, under most plausible conditions there is a case for additional base load capacity. There may only be sufficient generating capability provided that:

- energy consumption in Tasmania does not exceed the most recent medium economic growth projection published by NEMMCO;[23]
- Basslink energy imports approximately balance exports;
- hydro inflows return to their long-term average equivalent to 9,000 GWh per annum; and
- the existing Bell Bay Power Station continues to produce approximately 1,100 GWh per annum.

If the energy forecasts are exceeded, with either the hydro inflows below their long-term average or the ongoing operation of Bell Bay Power Station is not possible, then Tasmania would be relying heavily on net Basslink imports and wind farm generation. This risk is quite significant given the:

- age of the Bell Bay Power Station and its uncertain long term future;
- fact that hydro inflows have been approximately equivalent to 2,000 GWh per annum below their long term average for the past two years, with no current sign of this changing;
- energy available from a 130 MW wind farm is approximately 400 GWh per annum;[24] and
- large impact that a prolonged Basslink outage would have on electricity security in Tasmania.

While a prolonged outage of Basslink would be unlikely, its impact could be significant in the presence of an ongoing drought.

The Panel concluded in its draft report that, while the electricity supply in Tasmania appears to be sufficient given the present circumstances, there appeared to be potential risks to that supply if any one of the conditions above are not met. The Panel understands that since the publication of its draft report the risks to the electricity supply in Tasmania have not reduced. Therefore, the Panel considers there is a credible probability that a proponent for a new base load generation will be forthcoming. The Panel also notes that the most likely fuel sources for this new generation are gas and wind. To this end the Panel notes the TVPS and Gunns gas

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23 The NEMMCO "2008 Energy and demand projection" was published in July 2008 and is available on the NEMMCO website at http://www.nemmco.com.au/about/410-0100.pdf.

24 This estimate of the output of a wind farm is based on an average utilisation of 35%.

powered projects and the various potential wind farm projects discussed in submissions to the Review.

4.3.3 Opportunities for new gas generator technology development in Tasmania

Proponents wishing to connect a new gas powered generating unit are broadly faced with a choice between:

1. robust aero derivative gas turbines, either in open cycle operation or as part of combined cycle generator; and

2. large industrial combined cycle gas turbines.

Robust aero derivative gas turbines can operate under the existing Tasmanian *frequency operating standards*[25] however, compared to industrial combined cycle gas turbines, suffer from several disadvantages including:

- a capital cost approximately 12% higher than that for an industrial CCGT;[26]

- a short run marginal cost (SRMC) approximately 3% higher than that for an industrial CCGT;[27]

- increased maintenance requirements; and

- limited availability of steam turbines that comply with the current Tasmanian *frequency operating standards*.

As discussed above, the consequences of allowing large industrial CCGTs to connect in the Tasmanian power system is that the cost of R6 FCAS would rise, particularly at times of light load and higher Basslink imports. This would increase the FCAS prices and could in some instances, in the absence of any mitigation, lead to an FCAS shortage that would require intervention by NEMMCO. The Panel does note that the FCAS requirements can be dramatically reduced by limiting the size of the largest generator contingency under light conditions, although despite this, tightening of the standard itself does marginally increase the FCAS requirements.

4.3.4 CRA economic benefit cost assessment

The CRA benefit cost assessment for the Panel's draft report showed the impact on prices between robust aero derivative gas turbines and large industrial combined

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25 Some stakeholders, including Alinta, asserted aero derivative gas turbines could not be configured for combined cycle operation because the associated steam turbine would not meet the minimum access standards.

26 These indicative capital cost and SRMC comparisons are based on Hydro Tasmania's presentation to the Panel on 30 July 2008.

27 These indicative capital cost and SRMC comparisons are based on Hydro Tasmania's presentation to the Panel on 30 July 2008.

cycle gas turbines. The assessment showed that the lower capital and running costs of large industrial CCGTs outweigh the increased FCAS cost where there is a contingency limit. This result is generally consistent with the market modelling results produced by ROAM Consulting.[28]

The submissions from Hydro Tasmania and Aurora Energy on the Panel's draft report, and the associated CRA assessment, showed that an analysis that is based on price impacts is not robust as it:

- depends greatly on how often it is assumed the generating unit sets the price; and

- does not easily accommodate the price impacts in Victoria and the remainder of the NEM mainland.

For the Panel's final report, the CRA assessment was revised to be based on cost impacts. This reduces the sensitivity of the analysis to bidding assumptions and removes the need to estimate price impacts on the NEM mainland. This revised CRA assessment shows a smaller, but clear, marginal net benefit for changing the Tasmanian *frequency operating standards* to allow more efficient thermal gas turbines to operate provided the contingency size is limited to 144 MW.

The revised CRA assessment also showed that if a second more efficient thermal gas turbine was constructed the benefits would increase in proportion to the capacity, while the costs of tightening the standard would stay the same or reduce as the availability of R6 services increased.

Therefore, the Panel considers that improving opportunities for the further development of a wider choice of generation technologies in Tasmania to promote reliable and secure supplies warrants a set of standards. However, the economic and technical case is dependant on the size of the largest generating contingency being limited in some manner to prevent shortages of FCAS at times of light load.

4.3.5 Assessment of scenario C against the NEO

Under the NEO as defined in section 3.1.1, the Panel is required to assess the proposed change to the Tasmanian *frequency operating standards* in terms of the long term impacts on consumers of electricity.

Scenario C consists of tightening the Tasmanian *frequency operating standards* and imposing a limit on the size of the generator contingency size.[29]

The advice from NEMMCO and Transend shows that it may not be practical to change the standards without mitigating the impact on the FCAS requirements, with associated high costs and regular NEMMCO interventions. In addition, CRA's

[28] The ROAM analysis is contained in the supplementary submission from Alinta dated 29 July 2008.

[29] The increase in the contingency size in the case of the TVPS, if there were no limits in the standards, would move Tasmania from 144 MW to 210 MW.

analysis shows that the economic case for tightening the Tasmanian *frequency operating standards* strongly depends on limiting the contingency size to mitigate the resulting higher FCAS costs.

The Panel also notes the concern, raised by Hydro Tasmania and Roaring40s, that tightening the Tasmanian *frequency operating standards* may become a barrier to a large-scale penetration of wind generators in Tasmania. The Panel considers that scenario C does not increase the FCAS requirements excessively, compared to scenario D, and is therefore unlikely to have a significant detrimental impact on wind penetration.

Therefore, the Panel considers that scenario C would be likely to contribute to achieving the NEO for the following reasons:

- the tighter standard would allow higher efficiency thermal generating units to operate in Tasmania which should lower average energy costs for consumers in the long term;

- allowing higher efficiency thermal generating units to operate will increase the diversity of supply in Tasmania and would be likely to improve reliability and security of supply;

- the limit on the generator contingency size would reduce the FCAS costs, (compared to no contingency limit) and should reduce the long term prices of electricity to consumers; and

- the tighter standard, in the presence of a limit on the generator contingency size, would not materially affect NEMMCO's ability to maintain power system security compared to the existing arrangements.

4.4 Mechanism to mitigate the size of the largest contingency

4.4.1 Form of the mechanism to limit the generator contingency size

As discussed above, the feasibility of tightening the Tasmanian *frequency operating standards* currently depends on limiting the size of the generator contingency as the FCAS costs depend on both the *frequency operating standards* and the size of the largest contingency.

A limit on the generator contingency size could be implemented using a constraint equation in the NEMMCO dispatch process. For example, where the capacity of a generating unit is larger than the largest allowable generator contingency the associated generator could operate above the contingency limit by implementing an arrangement that is similar to the Basslink SPS, that is by automatically tripping contracted load whenever the new large generating unit trips such that the combined contingency size is limited. The ability of a large generation unit to operate up to its full capacity will not necessarily be restricted, provided contracted load is available to be tripped to limit the size of the resulting contingency. Such an automatic load shedding scheme would need to be approved by NEMMCO and included in the connection agreement with the associated network service provider.

Submissions from stakeholders to the draft report noted that a rigid contingency limit of 144 MW could lead to economic inefficiencies in the market. A more efficient method would be a contingency limit that alters dynamically through a constraint equation, either as a function of the system load or the associated FCAS costs.[30] The Panel considers that ideally the size of the contingency should be determined dynamically following an economic trade off between the benefits of the resulting generation and the costs of the associated FCAS. However, to date dynamic limits of this type have not been developed for use in the NEM and it is expected that their development would require significant time. Therefore, in the absence of this dynamic constraint equation, the Panel has decided to retain its draft decision and is proposing that a fixed limit on the contingency size of 144 MW be utilised. This contingency size limit equals the existing maximum generator contingency in Tasmania, can be implemented as soon as the change to the Tasmanian *frequency operating standards* take effect, and forms the basis of NEMMCO's advice.

4.4.2 Including a limit on the generator contingency size in the frequency operating standards

The Panel considers that including a limit on the generator contingency within the Tasmanian *frequency operating standards* is necessary for the Panel's decision to satisfy the NEO. Tightening of the Tasmanian *frequency operating standards* in the absence of a limit on the size of the generator contingency limit would cause costs that are likely to exceed the benefits and would be likely to lead to regular interventions by NEMMCO in order to maintain power system security.

4.4.3 Issues raised in submissions on the draft report

Inefficiency of a fixed 144 MW contingency limit

All submissions provided support to the principle of adopting a limit on the size of the allowable generator contingency. However, in its submission on the Panel's draft report Aurora Energy[31] indicated that a fixed limit of 144 MW is a waste of resources, particularly at times of high load and FCAS availability. Similarly, Aurora Energy Tamar Valley (AETV)[32] and Gunns[33] contended that a contingency limit of 160 MW would not be a problem for a significant portion of the time. In contrast, Hydro Tasmania[34] suggested that the contingency size for the Tamar Valley Power Station should be fixed at 110 MW for the first three years of its operation.

The Panel notes the concerns of the various stakeholders but considers that the generator contingency size limit should be 144 MW until an alternative approach can be developed and proven, as discussed in section 4.4.4 below. As the Panel considers

30 See section 4.4.3 below.

31 Aurora Energy's submission on the Panel's draft report, 3 October 2008.

32 AETV's submission on the Panel's draft report, 1 October 2008.

33 Gunns submission on the Panel's draft report, 10 October 2008.

34 Hydro Tasmania's submission on the Panel's draft report, 29 October 2008.

that the generator contingency limit should apply equally to all Tasmanian generators, a limit of less then 144 MW could impose a significant restriction on Tasmanian generation and could lead to reliability issues at times of high load.

Automatic load tripping scheme – speed of operation

NEMMCO in its addendum to the advice it provided to the Panel,[35] suggested that a scheme that automatically trips contracted load to limit the contingency size needs to operate in less than 600 milliseconds (ms). Discussions with Transend indicated that such schemes would generally operate within 200 ms and 400 ms.

The Panel considers that the operation of such a scheme to automatically trip load, including its speed of operation, must be approved by NEMMCO to ensure compliance with the Tasmanian *frequency operating standards*.

Expressing the generator contingency size in terms of an equivalent FCAS requirement

Roaring 40s[36] and Transend[37] identified that a delay in the operation of a scheme to automatically trip load would increase the FCAS requirement. To this end Roaring 40s proposed that the contingency size be capped at a level that "creates no greater R6 FCAS requirements than instantaneous loss of 144 MW supply at the regional reference node".[38]

The Panel notes that the speed of operation of the automatic load tripping scheme is important (as discussed above). However, the Panel considers that the generator contingency size should be calculated as the size of the generator less the size of the load that is automatically tripped because:

- the increase in FCAS requirements caused by the delay between a generator and its contracted load tripping can be minimised by NEMMCO requiring automatic tripping to operate sufficiently quickly; and
- expressing the contingency size in terms of an equivalent FCAS requirement would significantly increase the complexity of managing the frequency of the Tasmanian power system.

[35] NEMMCO's Addendum to their previous advice, 3 October 2008.

[36] Roaring 40s submission on the Panel's draft report.

[37] Transend's submission on the Panel's draft report.

[38] Roaring 40s submission to the Panel's draft report, p 1.

Relaxing the generator contingency size to avoid load shedding

In its addendum to the advice provided to the Panel, NEMMCO noted that to avoid (unnecessary) load shedding, it expected that the generator contingency limit could be relaxed.[39]

The Panel agrees that the contingency limit should be relaxed to avoid load shedding because:

- load shedding would only be likely when the load is high and FCAS is more available; and
- the contingency limit has been included in the Tasmanian *frequency operating standards* in an attempt to minimise FCAS costs, at times of low load, but these benefits would be swamped if it resulted in otherwise unnecessary load shedding.

The Panel envisages that NEMMCO would relax the generator contingency limit using a direction under clause 4.8.9 and has amended the final Tasmanian *frequency operating standards* to allow this.

Contingency limits for network events

Transend,[40] Roaring 40s[41] and NEMMCO[42] all discussed whether the contingency limit of 144 MW should apply to network contingencies as well. The examples sited in submissions were:

- an outage of the Gordon to Chapel Street transmission line; and
- the Musselroe wind farm that is exposed to a 100 km single circuit.

The Panel considers that the 144 MW contingency limit should not apply to network contingencies in Tasmania. In both cases, periods where the network contingency exceeds 144 MW would be relatively low as it would either be associated with a network outage or ideal wind conditions. In contrast, a large base load or intermediate thermal generating unit would be likely to operate above 144 MW for much of the time.

4.4.4 Future review of the limit on generator contingency size

The Panel considers that a limit on the generator contingency size is warranted in the absence of a mechanism to more accurately trade off between the contingency size and the associated FCAS costs. However, the Panel would subsequently consider

[39] Addendum to NEMMCO's advice to the Panel.

[40] Transend's submission on the Panel's draft report, p 10.

[41] Roaring 40s submission on the Panel's draft report is available on the AEMC website.

[42] Addendum to NEMMCO's advice to the Panel is available on the AEMC website.

removing this limitation on the contingency size if a more efficient alternative arrangement is implemented.

The Panel notes the concerns of many stakeholders that the 144 MW contingency limit would lead to inefficient outcomes at times of high load. Therefore, the Panel recommends that stakeholders, including NEMMCO, investigate mechanisms for relaxing the generator contingency size to deliver more economic dispatch of energy and FCAS, while maintaining system security with minimal intervention. Such mechanisms may include:

- enhancing NEMDE to co-optimise the contingency size and the FCAS requirement; or

- a constraint equation in NEMDE that approximates the co-optimisation process.

This generator contingency limit can only be removed from the Tasmanian *frequency operating standards* following a review by the Panel in accordance with clause 8.8.3 of the Rules and the NEO.

4.5 Recovering the costs of the increased FCAS requirements

While limiting the contingency size has the effect of significantly lowering the FCAS requirements and the associated costs, compared to tightening the standard without a contingency limit, the proposed changes to the Tasmanian *frequency operating standards* will nevertheless result in a small increase in the FCAS requirements, particularly those for R6. For example, at a Tasmanian demand of 900 MW, an additional 31 MW R6 FCAS is typically required if the lower limit of the single contingency *operational frequency tolerance band* is raised from the current 47.5 Hz to the proposed 48 Hz.

Under the existing mechanisms in the Rules many of the benefits of changing the Tasmanian *frequency operating standards* would be captured by the new higher efficiency generating unit, while the costs of the additional FCAS would be recovered from all generators.

The Panel considers that the following two alternative cost recovery mechanisms could also be explored:

- calculating the cost of the additional FCAS required to meet the tighter Tasmanian *frequency operating standards* and recovering this from the new higher efficiency thermal generating unit; or

- requiring the higher efficiency thermal generating unit to contract with an amount of additional FCAS that NEMMCO would take into account when procuring sufficient FCAS.

Both these cost recovery options are a form of “runway pricing” where the costs of the additional FCAS is recovered from the party that caused the additional need. However, both options have difficulties. The first cost recovery option requires an independent entity, such as NEMMCO, to calculate the additional requirements for each trading interval. The second option has the disadvantage that the actual additional requirement varies with the system load.

The Panel acknowledges the potential for possible Rules changes from stakeholders that consider an alternative arrangement, such as a form of "runway pricing", should apply. The implementation of any alternative cost recovery mechanisms could only occur through a formal Rule change process and consideration by the AEMC.

The Panel also notes that the NGF, Roaring 40s and Hydro Tasmania commented in their submissions to the Panel's draft report on the impact of cost recovery of changes to the *frequency operating standards*. This is discussed further in Appendix C.

4.6 Implementation – transitional arrangements

In its draft report the Panel requested that stakeholders who need to modify their systems as a result of the proposed changes to the Tasmanian *frequency operating standards* should indicate how long they would need and when the amended standards should take effect.

Transend and NEMMCO advised the Panel that all of the following issues need to be addressed before the revised Tasmanian *frequency operating standards* could take effect:

- the UFLSS needs to be redesigned and modified; and
- the OFGSS needs to be redesigned and modified; and
- the Basslink frequency controller needs to be modified; and
- the Basslink FCSPS needs to be modified; and
- new FCAS trapeziums need to be calculated and implemented for Tasmanian generating units.

Transend and NEMMCO advised the Panel that these issues could be addressed in approximately ten months following publication of the revised Tasmanian *frequency operating standards*. However, the Panel understands that there may be some scope for accelerating the timetable to address these issues.

Therefore, the Panel has determined that the revised Tasmanian *frequency operating standards* will take effect when the above issues have been addressed, and this should be completed by 31 December 2009. The Panel would consider extending this deadline if requested and following a public consultation process on the proposed later date in accordance with clause 8.8.3 of at least four weeks.

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5 Development of the revised Tasmanian frequency operating standards

The Panel has considered the benefit cost assessment prepared by its consultant (CRA), the information provided in the various submissions and its own analysis. It has decided to amend the Tasmanian *frequency operating standards* to the revised standards presented in this chapter, provided that the size of the generator contingency is limited to 144 MW.

Tables 5.1 and 5.2 present a summary of the revised Tasmanian *frequency operating standards* that would apply under interconnected and island conditions. Table 5.3 presents the values of the terms specifically to be used in the Rules. A full description of the revised Tasmanian *frequency operating standards* is presented in Appendix A.

Table 5.1 Revised Tasmanian frequency operating standards – interconnected system

Condition	Containment	Stabilisation	Recovery
Accumulated time error	15 seconds		
Normal	49.75 to 50.25 Hz, 49.85 to 50.15 Hz 99% of the time	49.85 to 50.15 Hz within 5 mins	
Load and generation event	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 mins	
Network event	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 mins	
Separation event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 mins	49.85 to 50.15 Hz within 10 mins
Multiple contingency event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 mins	49.85 to 50.15 Hz within 10 mins

Table 5.2 Revised Tasmanian frequency operating standards – island operation

Condition	Containment	Stabilisation	Recovery
Normal	49.0 to 51.0 Hz		
Load and generation event	48.0 to 52.0 Hz	49.0 to 51.0 Hz within 10 mins	
Network event	48.0 to 52.0 Hz	49.0 to 51.0 Hz within 10 mins	
Separation event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 mins	49.0 to 51.0 Hz within 10 mins
Multiple contingency event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 mins	49.0 to 51.0 Hz within 10 mins

Table 5.3 Revised Tasmanian frequency operating standards – Rule terms

Term	Normal range (Hz)	Island range (Hz)
normal operating frequency band	49.85 to 50.15	49.0 to 51.0
normal operating frequency excursion band	49.75 to 50.25	49.0 to 51.0
operational frequency tolerance band	48.0 to 52.0	48.0 to 52.0
extreme frequency excursion tolerance limit	47.0 to 55.0	47.0 to 55.0

5.1 Amendments to the Tasmanian frequency operating standards

In developing the revised Tasmanian *frequency operating standards*, presented above and in Appendix A, the Panel has considered each aspect of the existing standards.

5.1.1 Normal operating bands

The normal operating band, also referred to in the Rules as the *normal operating frequency band* and *normal operating frequency excursion band*, specifies the allowable frequency deviations in the absence of a contingency that occur due to the natural variation of the system load, small generator non-conformances or forecasting errors. NEMMCO procures sufficient regulating FCAS to ensure that the frequency remains within the normal operating band in the absence of a contingency.

Neither the NEMMCO advice[43] nor any of the submissions proposed or supported a change to the normal operating frequency bands. The Panel also notes that the existing normal operating frequency bands are the same as those that apply on the

[43] The advice received from NEMMCO in accordance with clause 8.8.1(a)(2) of the Rules, and published on the AEMC website.

NEM mainland for interconnected conditions, although the normal bands for island conditions are 49.5 to 50.5 Hz on the NEM mainland. Therefore, the Panel is making no change to the normal operating bands for either interconnected operation or island operation.

5.1.2 Under frequency bands

As discussed in Chapter 4, the Panel is amending the Tasmanian *frequency operating standards* so that higher efficiency thermal generating units can be connected and operated in Tasmania. The greatest barriers to the connection of such generating units are the requirements to operate for the relatively low frequencies currently allowed under the Tasmanian *frequency operating standards*. To reduce these barriers the Panel is amending the lower limits of the *extreme frequency excursion tolerance limit* and the *operational frequency tolerance band* .

Extreme frequency excursion tolerance limit

Higher efficiency thermal generating units are less tolerant to low frequencies than the existing generating units in Tasmania and are generally required to trip at approximately 47 Hz.

Therefore, the Panel is amending the lower limits of the separation event and multiple contingency event bands, and the *extreme frequency excursion tolerance limit*, by raising these limits to 47 Hz from the current value of 46 Hz.

Operational frequency tolerance band

If the lower limit of the *extreme frequency excursion tolerance limit* is raised to 47 Hz then it is necessary to raise the *operational frequency tolerance band* to allow sufficient margin for the Tasmanian UFLS to operate without a single credible contingency causing unintended load shedding.

At present the Tasmanian UFLSS operates from 47.5 Hz down to 46 Hz. However, NEMMCO and Transend advised that they consider that the operation of the UFLSS could be compressed to 1 Hz, thus operating from 48 Hz down to 47 Hz.[44] In addition, higher efficiency thermal generating units are generally required to minimise the periods of operation below 48 Hz to prevent significant loss of life of the plant to reduce excessive maintenance and risks of catastrophic failure.

Therefore, the Panel is amending the lowest allowable frequency for a single credible contingency to 48 Hz. This has been achieved in the revised Tasmanian *frequency operating standards* by raising the lower limit of the generator and network event

44 Reference Transend (23 May 2008) and NEMMCO advice on UFLSS.

bands, and the lower limit of the *operational frequency tolerance band*, to 48 Hz from the current value of 47.5 Hz.[45]

5.1.3 Over frequency bands

Higher efficiency thermal generating units are also less tolerant to high frequencies than the existing generating units in Tasmania and are generally required to trip at approximately 52 Hz.

However, under schedule S5.2.5.3(c)(5) and (6) of the Rules, a generating unit can meet the minimum access standards for over frequency ride through requirements if it has a protection system to trip the unit if the frequency exceeds a level agreed with NEMMCO. Under schedule S5.2.5.3(c)(5) NEMMCO can choose any tripping frequency above the upper bound of the *normal operating frequency band*. However, NEMMCO would not normally allow a generator to trip below the upper limit of the *operational frequency tolerance band* because the generating unit could be exposed to this frequency for a single credible load or network event.[46]

Therefore, the Panel is:

- not changing the upper limit of the *extreme frequency excursion tolerance limit* of 55 Hz;[47] and
- amending the upper limit for the *operational frequency tolerance band* to 52 Hz.[48]

The Panel considers that aligning the upper limit of the *operational frequency tolerance band* for load, generator and network events to 52 Hz, would allow higher efficiency thermal generating units to meet the minimum access standards in respect to the frequency ride through requirements in schedule 5.2.5.3 of the Rules.[49]

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45 The lower limit of the load event band is currently set to 49 Hz, however, the Panel has made the limit equal to the limits for the generator and network event bands.

46 See NEMMCO's submission to the and/or Rule change. NEMMCO may make an exception if the unit needed to trip at a frequency that was not significantly below the upper limit of the *operational frequency tolerance band* and the size of the resulting contingency was small, but this would be a matter for NEMMCO when it coordinates the operation of the OFGSS.

47 The Panel has accepted that the same *operational frequency tolerance band* and *extreme frequency excursion tolerance limit* apply for both interconnected and island conditions.

48 The Panel has accepted that the same *operational frequency tolerance bands* apply for load, generator and network events.

49 Gunns indicated that its cogeneration plant would trip at 51.6 Hz, causing a 60 MW contingency. In principle, this also meets the minimum access standards in schedule 5.2.5.3(c)(5) of the Rules as NEMMCO could accept a tripping frequency as low as 51.0 Hz, the normal operating band for island operation, however there would be a risk that the Gunns unit would trip for a large single load or network event. NEMMCO's advice is that the alternative of lowering the upper limit of the single contingency band below 52 Hz would not be practical because of the impact on the FCAS lower requirements. The Panel expects that NEMMCO would only accept a generating unit tripping following a single load or network event if it caused only a small contingency and it could be effectively integrated into the OFGSS.

The Panel also acknowledges that it may be impossible to design the OGFSS to manage an island condition where there is a large imbalance between the generation and load within the island. Under these conditions, the Panel considers that it is in the long term interests of consumers to allow the affected generating units to self protect at frequencies above 55 Hz, or as agreed with NEMMCO, rather than risk damage and prolong outages of these generating units.

5.1.4 Load, generator and network events

At present the Tasmanian *frequency operating standards* have separate frequency bands for load, generator and network events. However, Transend identified the potential to simplify the standards.[50] Transend summarised its recommended changes in Tables 2 and 3 of its submission.

When developing the revised Tasmanian *frequency operating standards*, the Panel has considered the recommendations from Transend, and the NEMMCO advice, and in some cases made further simplifications.

Amalgamating the load event and the network event bands

Currently the load and network event bands are 49 to 51 Hz and 47.5 to 53 Hz respectively.

Transend proposed that the upper limits of both bands be amended to 52 Hz for simplicity and to remove an inconsistency in the calculation of FCAS lower.[51] Tightening the network event band to 52 Hz would be necessary to align with the *operational frequency tolerance band* while increasing the upper limit of the load event band to 52 Hz reduces the fast FCAS lower requirements. Transend also noted that the *market ancillary service specification*[52] could be updated for Tasmania so that the test signal used for calculating the FCAS lower capability aligns with the actual frequency limit being controlled to.

The Panel considered that aligning the lower limit of the load event band to 48 Hz would have no material affect as the primary requirement following a load event is to manage the over frequency.

Therefore, the Panel agrees with Transend and is amending the standards by combining the load event and the network bands in the revised Tasmanian *frequency operating standards*.

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[50] Transend submission of 23 May 2008.

[51] See section 3.1.1 of the Transend submission of 23 May 2008.

[52] Has the meaning given in clause 3.11.2(b) of the Rules.

Upper limit of the generator event band

Transend discusses the possibility of raising the upper limit of the generator event band from 51 Hz to 52 Hz and it concludes that leaving the limit at 51 Hz would be appropriate because the remote possibility of an over frequency to 52 Hz may cause inadvertent over frequency tripping of some generating units.

The Panel notes that the upper limit of the load and generator events bands are identical in the NEM mainland *frequency operating standards,*[53] and it considers that the risk of a single generator event causing another generating unit to inadvertently trip on over frequency to be remote, given that NEMMCO would be procuring sufficient FCAS to limit the frequency to 52 Hz for a generator event.

Therefore, the Panel is amending the upper limit of the generator event band to 52 Hz to align it with the *operational frequency tolerance band* and the load and network event limits. The Panel considers this would provide simplicity and better alignment with the NEM mainland, without introducing any additional material risk.

Lower limits of the load, generator and network events

Currently the lower limit of the generator and network event bands is 47.5 Hz and the lower limit of the load event band is 49 Hz. The Panel notes that the lower limit of the generator and network event bands need to be raised to 48 Hz to align with the *operational frequency tolerance band*.

The Panel also considers that the lower limit of the load event band should be lowered to 48 Hz to align with the generator and network event bands. The Panel considers that this would have little or no effect on the FCAS raise requirements and would simplify the standards, without introducing a material risk to system security. In making this amendment the Panel notes that the lower limit of the load and generator events on the NEM mainland are equal.

5.1.5 Stabilisation and recovery values

Load, generator and network events

Currently the recovery time for generator and network events is 5 minutes while the recovery time for load events is 10 minutes. This difference was introduced by the TRNPP in its last review of the Tasmanian *frequency operating standards* in 2006,[54] and was adopted by the Panel in its initial review in 2006. The TRNPP stated that:

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[53] The NECA determination on the NEM mainland *frequency operating standards* is available on the AEMC website.

[54] TRNPP 2006 review, available on the website of the Office of the Tasmanian Energy Regulator located at http://www.otter.tas.gov.au.

The stabilisation and recovery time for a load event has been increased from 5 to 10 minutes. This addresses a problem experienced by a major customer due to the 5 minute dispatch interval in the NEM where it was being asked to delay restoration until sufficient ancillary services had been dispatched in the following interval to avoid excessive frequency excursions when the load is switched back in.[55]

Transend indicated in its submission that the "increase in allowable time from 5 minutes to 10 minutes to recover to within the *normal operating frequency band* provided NEMMCO with an additional dispatch interval to procure more regulating FCAS (from the market) without breach of the frequency standards in the meantime".[56] Transend noted that this set a precedence whereby operation in the range 49 to 51 Hz for up to 10 minutes was deemed acceptable from a power quality perspective. Therefore, it considered that the recovery times for generation and network events could be extended to 10 minutes if both the bands are tightened to 48 Hz to 52 Hz.

Transend also considered that a stabilisation requirement of 49 to 51 Hz within 5 minutes should apply following a single contingency event. The Panel has not included this requirement in its revised Tasmanian *frequency operating standards* for simplicity because the single event bands have been tightened (48 to 52 Hz) and the frequency must in any case be within the *normal operating frequency band* within 10 minutes.

Multiple contingencies and separation events

Neither the NEMMCO advice nor any of the submissions proposed or supported a change to the stabilisation and recovery bands and times, other than consequential changes due to changes to the containment bands for normal and the single event bands. Therefore, the Panel is not changing the stabilisation and recovery bands and times, other than aligning them to the amended *normal operating frequency bands* and the *operational frequency tolerance bands*.

5.2 Accumulated time error

The existing accumulated time error is 15 seconds and it applies whenever the Tasmanian power system is intact. Transend[57] advised that the existing accumulated time error can be exceeded following separation or multiple contingency events, which is consistent with the advice from NEMMCO.

The Panel considers that the value of the accumulated time error should continue to be 15 seconds. In addition, the Panel notes that this value may be difficult to achieve following separation or multiple contingency events and, given that the accumulated

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55 Submission made to the Panel by the TRNPP in April 2006 as part of the Panel's initial review of the Tasmanian frequency operating standards, published in May 2006.

56 Transend's submission to the Panel's draft report, p ???

57 Transend submission of 23 May 2008.

time error is not critical for system security, is proposing to relax the requirement so that it only applies during normal operation and following single contingency events.

A Revised Tasmanian frequency operating standards

The Panel is amending, in accordance with clause 8.8.3 of the Rules and section 38 of the NEL, the Tasmanian *frequency operating standards* to be those contained in this Appendix.

Part A Summary of the Standards

The *Tasmanian frequency operating standards* set out in Part B of this appendix are summarised in the following tables for convenience. To the extent of any inconsistency between these tables and Part B below, Part B prevails. Table A1 applies to any part of the Tasmanian *power system*:

A1: Revised Tasmanian frequency operating standards – interconnected system

CONDITION	CONTAINMENT	STABILISATION	RECOVERY
Accumulated time error (other than multiple contingency events)	15 seconds		
Normal	49.75 to 50.25 Hz, 49.85 to 50.15 Hz 99% of the time	49.85 to 50.15 Hz within 5 minutes	
Load and generation event	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 minutes	
Network event	48.0 to 52.0 Hz	49.85 to 50.15 Hz within 10 minutes	
Separation event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes
Multiple contingency event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 minutes	49.85 to 50.15 Hz within 10 minutes

Table A2 applies to an *island* within the Tasmanian *power system*:

A2: Tasmanian frequency operating standards – island operation

CONDITION	CONTAINMENT	STABILISATION	RECOVERY
Normal	49.0 to 51.0 Hz		
Load and generation event	48.0 to 52.0 Hz	49.0 to 51.0 Hz within 10 minutes	
Network event	48.0 to 52.0 Hz	49.0 to 51.0 Hz within 10 minutes	
Separation event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 minutes	49.0 to 51.0 Hz within 10 minutes
Multiple contingency event	47.0 to 55.0 Hz	48.0 to 52.0 Hz within 2 minutes	49.0 to 51.0 Hz within 10 minutes

Part B The Frequency operating standards

For the purposes of the *Rules*, the *frequency operating standards*, forming part of the *power system security and reliability standards*, that apply in Tasmania are:

(a) except in an island or following a *multiple contingency event*, the *accumulated time error* should not exceed 15 seconds;

(b) except as a result of a *contingency* or a *load event*, *system frequency* should not exceed the applicable *normal operating frequency excursion band* and should not exceed the applicable *normal operating frequency band* for more than five minutes on any occasion and for not more than 1% of the time over any 30 day period;

(c) as a result of a *generation event*, *system frequency* should not exceed the applicable *generation change band* and should not exceed the applicable *normal operating frequency band* for more than 10 minutes;

(d) as a result of a *load event*, *system frequency* should not exceed the *load change band* and should not exceed the applicable *normal operating frequency band* for more than 10 minutes;

(e) as a result of any *network event*, *system frequency* should not exceed the applicable *operational frequency tolerance band* and should not exceed the applicable *load change band* for more than one minute or the applicable *normal operating frequency band* for more than 10 minutes;

(f) as a result of any *separation event*, *system frequency* should not exceed the applicable *island separation band* and should not exceed the applicable *load change band* for more than two minutes or the applicable *normal operating frequency band* for more than 10 minutes;

(g) as a result of any *multiple contingency event*, *system frequency* should not exceed the applicable *extreme frequency excursion tolerance limits* and should not exceed the applicable *load change band* for more than two minutes while there is no *contingency event* or the applicable *normal operating frequency band* for more than 10 minutes while there is no *contingency event*;

(h) the size of the largest single generator event is limited to 144 MW[58], which can be implemented for any *generating system* with a capacity that is greater than 144 MW by the automatic tripping of load;

(i) these *frequency operating standards* will take effect on completion of the following:

(i) under frequency load shedding scheme (UFLSS); and

(ii) over-frequency generator shedding scheme (OFGSS); and

(iii) revised FCAS trapeziums and control settings for Tasmanian generating units; and

(iv) frequency control special protection scheme (FCSPS); and

(v) Basslink frequency controller;

which must be no later than 31 December 2009, or a date agreed by the *Reliability Panel* in accordance with the consultation process under clause 8.8.3.

Part C Application of Rules terms

For the purposes of these *frequency operating standards* and the Rules, a term shown in column 1 of the following table has the corresponding range shown in column 3 of the table for an *island* and has the corresponding range shown in column 2 of the Table otherwise.

Tasmanian Frequency Operating Standards – Rule terms

Term	Normal range (Hz)	Island range (Hz)
normal operating frequency band	49.85 to 50.15	49.0 to 51.0
normal operating frequency excursion band	49.75 to 50.25	49.0 to 51.0
operational frequency tolerance band	48.0 to 52.0	48.0 to 52.0
extreme frequency excursion tolerance limit	47.0 to 55.0	47.0 to 55.0

58 *NEMMCO* may in accordance with clause 4.8.9 direct a *Generator* to exceed the 144 MW contingency limit if *NEMMCO* reasonably believes this would be necessary in order to maintain a *reliable operating state*.

Part D Definitions

Words and phrases shown in italics in this document have the meaning given to the in the following table:

Revised Tasmanian frequency operating standards – glossary

Term	Reference	Meaning
Accumulated time error		*Accumulated time error* means, in respect of a measurement of *system frequency* that *NEMMCO* uses for controlling *system frequency*, the integral over time of the difference between 20 milliseconds and the inverse of that *system frequency*, starting from a time published by *NEMMCO*
Rules		The Rules means National Electricity Rules
Connection point	Glossary - NER	The agreed point of supply established between *Network Service Provider(s)* and another *Registered Participant*, Non-Registered Customer or franchise customer.
Contingency event	Clause 4.2.3(a) – NER	A "*contingency event*" means an event affecting the *power system* which *NEMMCO* expects would be likely to involve the failure or removal from operational service of a *generating unit* or *transmission element*.
Credible contingency event	Clause 4.2.3(b), Schedule 5.1 – NER	A "*credible contingency event* " means a *contingency event* the occurrence of which *NEMMCO* considers to be reasonably possible in the surrounding circumstances including the *technical envelope*. Without limitation, examples of *credible contingency events* are likely to include: • the unexpected automatic or manual disconnection of, or the unplanned reduction in capacity of, one operating *generating unit*; or • the unexpected disconnection of one major item of *transmission plant* (e.g. transmission line, transformer or reactive plant) other than as a result of a three phase electrical fault anywhere on the *power system*.

Term	Reference	Meaning
Extreme frequency excursion tolerance limits	Glossary - NER	In relation to the frequency of the *power system*, means the limits so described and specified in the *power system security and reliability standards*.
Generating unit	Glossary - NER	The actual *generator* of electricity and all the related equipment essential to its functioning as a single entity.
Generating system	Glossary - NER	(a) Subject to paragraph (b), for the purposes of the *Rules*, a system comprising one or more *generating units*. (b) For the purposes of clause 2.2.1(e)(3), clause 4.9.2, Chapter 5 and a jurisdictional derogation from Chapter 5, a system comprising one or more *generating units* and includes auxiliary or reactive plant that is located on the *Generator's* side of the *connection point* and is necessary for the *generating system* to meet its *performance standards*.
Generation	Glossary - NER	The production of electrical power by converting another form of energy in a *generating unit*.
Generation change band		means the frequency range of 48.0 to 52.0 Hz in respect of an island and otherwise.
Generation event		means a *synchronisation* of a *generating unit* of more than 50 MW or a *credible contingency event* in respect of either a single *generating unit* or a *transmission element* solely providing *connection* to a single *generating unit*, not arising from a *network event*, *a separation event* or a part of a *multiple contingency event*.
Interconnector	Glossary - NER	A *transmission line* or group of *transmission lines* that connects the *transmission networks* in adjacent regions.
Island		means a part of the Tasmanian *power system* that includes *scheduled generation*, *networks* and *load* for which all of its alternating current network connections with other parts of the *power system* have been disconnected
Island separation band		means the *extreme frequency excursion tolerance limits*

Term	Reference	Meaning
Load	Glossary - NER	A *connection point* or defined set of *connection points* at which electrical power is delivered to a person or to another *network* or the amount of electrical power delivered at a defined instant at a *connection point*, or aggregated over a defined set of *connection points*
Load change band		means the frequency range of 48.0 to 52.0 Hz in respect of an island and otherwise.
Load event		means an either an identifiable increase or decrease of more than 20 MW of customer load (whether at a *connection point* or otherwise), or a rapid change of flow by a *high voltage* direct current interconnector to or from 0 MW for the purpose of starting, stopping or reversing its power flow, not arising from a *network event*, a *generation event*, a *separation event* or a part of a *multiple contingency event*
Market network service provider	Glossary - NER	A *Network Service Provider* who has classified any of its *network services* as a *market network service* in accordance with Chapter 2 and who is also registered by *NEMMCO* as a *Market Network Service Provider* under Chapter 2.
Multiple contingency event		means either a *contingency event* other than a *credible contingency event*, a sequence of *credible contingency events* within a period of 5 minutes, or a further *separation event* in an island
National grid	Glossary - NER	The sum of all *connected transmission* and *distribution systems* within the participating jurisdictions
NEMMCO	Glossary - NER	National Electricity Market Management Company Limited A.C.N. 072 010 327.
Network	Glossary - NER	The apparatus, equipment, *plant* and buildings used to convey, and control the conveyance of, *electricity* to *customers* (whether *wholesale* or *retail*) excluding any connection assets. In relation to a *Network Service Provider*, a *network* owned, operated or controlled by that *Network Service Provider*
Network event		means a *credible contingency event* other that a *generation event*, a *separation event* or a part of a *multiple contingency event*

Term	Reference	Meaning
Normal operating frequency band	Glossary - NER	In relation to the *frequency* of the *power system*, means the range 49.85 Hz to 50.15 Hz or such other range so specified in the *power system security and reliability standards*.
Normal operating frequency excursion band	Glossary - NER	In relation to the *frequency* of the *power system*, means the range specified as being acceptable for infrequent and momentary excursions of *frequency* outside the *normal operating frequency band*, being the range of 49.75 Hz to 50.25 Hz or such other range so specified in the *power system security and reliability standards*.
Operational frequency tolerance band	Glossary - NER	The range of *frequency* within which the *power system* is to be operated to cater for the occurrence of a *contingency event* as specified in the *power system security and reliability standards*.
Power system	Glossary - NER	The electricity *power system* of the *national grid* including associated *generation* and *transmission* and *distribution networks* for the supply of *electricity*, operated as an integrated arrangement.
Power system security and reliability standards	Glossary - NER	The standards governing *power system security and reliability* of the *power system* which are approved by the *Reliability Panel* on the advice of *NEMMCO*. They may include but are not limited to standards for the *frequency* of the *power system* in operation, contingency capacity reserves (including guidelines for assessing requirements and utilisation), *short term capacity reserves*, *medium term capacity reserves* and *system restart*.
Publish	Glossary - NER	Make available to *Registered Participants* electronically.
Separation event		means a *credible contingency event* in relation to a *transmission element* that forms an island.
Synchronisation	Glossary - NER	The act of synchronising a *generating unit* or a scheduled *network service* to the *power system*.
System frequency		means the *frequency* of a part of the *power system*, including the *frequency* of an island.

Term	Reference	Meaning
Technical envelope	NER Clause 4.2.5	means the technical boundary limits of the *power system* for achieving and maintaining a *secure operating state* of the *power system* for a given *demand* and *power system* scenario.
Transmission line	Glossary NER	A power line that is part of a *transmission network*.
Transmission element	Glossary - NER	A single identifiable major component of a *transmission system* involving: (a) an individual *transmission circuit* or a phase of that circuit; (b) a major item of *transmission plant* necessary for the functioning of a particular *transmission circuit* or *connection point* (such as a transformer or a circuit breaker).
Transmission network	Glossary - NER	A *network* within any participating jurisdiction operating at *nominal voltages* of 220 kV and above plus: any part of a *network* that operates at *nominal voltages* between 66 kV and 220 kV that operates in parallel to and provides support to the *high voltage transmission network*; any part of a *network* that operates at *nominal voltages* between 66 kV and 220 kV that is not referred to in paragraph (a) but is deemed by the *AER* to be part of the *transmission network*.

B Stakeholder consultation

This Appendix is a list that summarises the initial stakeholder comments that were received and considered by the Panel prior to it preparing its draft report:

B.1 Initial stakeholder comments

Entity	Dated	Comment
Alinta	24 April 2008	Letter
		Submission (revised 21 May 2008)
		extract from submission (revised 5 June 2008)
Basslink	23 April 2008	
Department of Infrastructure, Energy and Resources	28 September 2007	Prepared by ETAC and supplied by the Jurisdiction
Aurora	23 May 2008	
Gunns	23 May 2008	
Hydro Tasmania	23 May 2008	Letter and submission
Roaring40s	23 May 2008	
Transend	23 May 2008	Letter and submission
TRUenergy	23 May 2008	
National Generators Forum	28 May 2008	
David Llewellyn	21 May 2008	Letter from the Tasmanian Minister
Transend	25 July 2008	Presentation to ETAC
Alinta	24 July 2008	
Alinta	29 July 2008	
Alinta	30 July 2008	Presentation to the Panel
Alinta	25 July 2008	ROAM report (Stage 1)
Alinta	29 July 2008	ROAM report (Stage 2)
Hydro Tasmania	1 August 2008	Letter
		Responses to the Panel
		Proposal
		Confidential Information
Hydro Tasmania	30 July 2008	Presentation to the Panel
Roaring 40s	4 August 2008	Letter and submission

Entity	Dated	Comment
Hydro Tasmania	6 August 2008	Presentation to the Panel
Transend	7 August 2008	Letter and submission
Alinta	7 August 2008	
Hydro Tasmania	7 August 2008	

B.2 Presentations at stakeholder forum in Hobart on 6 June 2008

- Chairman of the Reliability Panel
- Office of Energy Planning and Conservation
- Transend
- Gunns
- Hydro Tasmania
- Roaring 40s
- Basslink

B.3 Submissions on the Draft Report

Entity	Dated	Comment
Aurora Energy	3 October 2008	
Aurora Energy (Tamar Valley)	1 October 2008	
Eureka Funds Management	3 October 2008	
Gunns Limited	10 October 2008	
Hydro Tasmania	29 October 2008	Letter and submission
NGF	3 October 2008	
Roaring 40s	3 October 2008	
Transend Networks		Letter and submission

B.4 Presentations at stakeholder forum in Hobart on 30 October 2008

- Chairman of the Reliability Panel
- Aurora Energy
- Hydro Tasmania (no slides or transcript provided)
- Roaring 40s
- Aurora Energy Tamar Valley

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C Initial stakeholder comments - benefit cost assessment

This Appendix summarises the views raised by stakeholders in their initial comments prior to the Panel making this final report.

C.1 How the Review will or is likely to contribute to the achievement of the national electricity objective

Stakeholders suggested that the Review could contribute to achieving the NEO by:

- "creating and applying a market environment and rules that promote efficient investment adequate to meet the current and prospective demand, the efficient dispatch of generation, and continuing high standards of security and performance";[60]
- "a package of frequency standards and a rule change or alternative mechanism as another way for new entrant generators to meet minimum access standards under the Rules" which "minimises costs, maximises benefits";[61]
- avoid aligning the Tasmanian *frequency operating standards* with the mainland *frequency operating standards* in the NEM for the sole reason of consistency;[62] and
- "the Reliability Panel undertake a thorough assessment of the potential costs of tightening the standards, to ensure they are set at a level which maximises the net benefits to consumers over the long term".[63]

C.2 The expected benefits and costs of the Review and the potential impacts of the Review on those likely to be affected

This section presents the Panel's explanation of the expected benefits and costs of the Review to the existing Tasmanian *frequency operating standards*. This includes the potential impacts of the Review on those likely to be affected.

Stakeholders commented on the expected benefits of tightening the Tasmanian *frequency operating standards*:

- lower electricity prices for consumers;[64]
- it would be beneficial if generator competition is encouraged;[65]

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60 The Hon David Llewellyn MP submission, 21 May 2008, p. 1.

61 Hydro Tasmania submission, 23 May 2008, p. 2.

62 TRUenergy submission, 23 May 2008, p. 1.

63 NGF submission, 28 May 2008, p. 2.

64 Alinta submission, 24 April 2008, p. 2.

- future demand could be met;[66]
- other market benefits of thermal plant;[67]
- provides voltage support for the power system;[68]
- system inertia provided by the new thermal entry;[69]
- incremental benefit of facilitating connection of additional renewable technologies in Tasmania should be considered;[70]
- improvements in long term security and reliability benefits through improved plant mix and greater fuel diversity in Tasmania;[71] and
- additional capacity from the new plant.[72]

Stakeholders also indentified the expected costs of tightening the Tasmanian *frequency operating standards*:

- cost to consumers should be minimal;[73]
- experiences in similar overseas systems have concluded that the compliance costs to wider frequency band operation outweighs the cost of a tighter *frequency operating standard*;[74]
- comparisons should be made between the increased cost of FCAS in operating to a tighter band and the cost of plant compliance and increased energy cost;[75]
- an evaluation should be undertaken on the forecast combined energy reserve cost, with and without a new standard;[76]
- the reliability costs of thermal units should be considered;[77]

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65 Aurora Energy submission, 23 May 2008, p.3; TRUenergy submission, 23 May 2008, p.2; NGF submission, 28 May 2008, p.2; Alinta supplementary submission, 24 July 2008, p. 11.

66 Aurora Energy submission, 23 May 2008, p. 3.

67 Aurora Energy submission, 23 May 2008, p. 3.

68 Aurora Energy submission, 23 May 2008, p. 3.

69 Aurora Energy submission, 23 May 2008, p. 4; Roam Consulting report in Alinta supplementary submission, , 24 July 2008, p. II.

70 Roaring 40s submission, 23 May 2008, p. 4.

71 NGF submission, 28 May 2008, p. 2.

72 Roam Consulting report in Alinta supplementary submission, 24 July 2008, p. II.

73 Aurora Energy submission, 23 May 2008, p. 3.

74 Gunns submission, 23 May 2008, p. 6.

75 Gunns submission, 23 May 2008, p. 6.

76 Gunns submission, 23 May 2008, p. 6.

77 Gunns submission, 23 May 2008, p. 6.

- FCAS costs in lost water from inefficient machines to supply FCAS should be based on the water opportunity cost and costs of the new FCAS supply should be determined;[78]
- the current and 210W contingency should be considered to determine the viability and costs of any proposed change following the commissioning of the Alinta plant;[79]
- the cost of installing CCGT plant designed for the existing Tasmanian system is low compared with the costs in accommodating less suitable plant;[80]
- the total costs of contingency services could more than double with a tighter *frequency operating standard*;[81]
- lower cost alternative mechanisms such as a Rule change or out-of-market arrangements as opposed to changing the Tasmanian *frequency operating standards* should be considered;[82]
- potential increases in FCAS costs may have an impact on distribution network service providers and may limit their opportunities to offset price rises with FCAS earnings;[83]
- likely increases in costs to both existing customers and generators in Tasmania if the Tasmanian *frequency operating standards* were aligned with the NEM for the sole reason of consistency;[84]
- the FCAS raise cost to generators in Tasmania will increase;[85]
- the cost of lower services to customers will increase;[86]
- the cost of entry to less frequency sensitive entrants will increase;[87]
- the cost for wind resources will increase;[88]

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78 Hydro Tasmania submission, 23 May 2008, p. 10, and Roaring 40s submission, 4 August 2008, p. 1.

79 Hydro Tasmania submission, 23 May 2008, p. 10.

80 Roaring 40s submission, 23 May 2008, p. 2.

81 Roaring 40s submission, 23 May 2008, p. 4.

82 Roaring 40s submission, 23 May 2008, p. 4.

83 Transend submission, 23 May 2008, p. 16.

84 TRUenergy submission, 23 May 2008, p. 1.

85 TRUenergy submission, 23 May 2008, p. 2 and in Hydro Tasmania presentation slides dated 4 August 2008.

86 TRUenergy submission, 23 May 2008, p. 2.

87 TRUenergy submission, 23 May 2008, p. 2.

88 TRUenergy submission, 23 May 2008, p. 2; Roaring 40s supplementary submission, 4 August 2008, p. 3.

- examination of cost recovery mechanisms in the FCAS market may need to be examined;[89]
- direct and indirect costs of altering existing systems to accommodate tighter *frequency operating standards* should be taken into account;[90]
- generators in Tasmania would only be able to recover local FCAS costs 10% of the time;[91] and
- full costs would not be recoverable in FCAS raise markets which will increase energy prices for customers.[92]

The potential impacts of the change on those likely to be affected were also noted by stakeholders:

- a tighter *frequency operating standard* will require more FCAS to be scheduled;[93]
- a condition on the Tasmanian *frequency operating standard* is that it should not place unnecessary technical barriers to entry of generation technologies; [94]
- the tightening of the *frequency operating standard* could be limited by the availability and cost of fast ancillary services and the frequency of VoLL events;[95]
- additional FCAS would significantly affect water usage, and wear and tear on hydro plant;[96]
- credible scenarios resulting from changing the Tasmanian *frequency operating standards* and rule changes should be developed;[97]
- changes to the Tasmanian *frequency operating standards* should be cognisant of likely developments for the foreseeable future;[98]
- the costs and benefits should be assessed on a NEM wide basis with the NEO;[99]
- the net impact on energy and capacity available to Tasmania should be considered for the short, medium and long terms;[100]

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89 TRUenergy submission, 23 May 2008, p. 2.

90 NGF submission, 28 May 2008, p. 2.

91 Hydro Tasmania supplementary submission, 1 August 2008, p. 4.

92 Hydro Tasmania presentation to Reliability Panel in supplementary submission, 1 August 2008, p. 12.

93 Aurora Energy submission, 23 May 2008, p. 4.

94 Aurora Energy submission, 23 May 2008, p. 3.

95 Aurora Energy submission, 23 May 2008, p. 4.

96 Hydro Tasmania supplementary submission, 1 August 2008, p. 3.

97 Hydro Tasmania submission, 23 May 2008, p. 10.

98 Hydro Tasmania submission, 23 May 2008, p. 10.

99 Hydro Tasmania submission, 23 May 2008, p. 10.

- attribution of the costs and benefits should be done in a manner that ensures a reasonable level of equity in any decision;[101]

- the impacts on the costs of developing Tasmania's wind energy resources and reducing its ability to use Basslink should be considered; [102]

- the expected changes in FCAS requirements for single credible contingency events should be considered;[103]

- direct impacts on existing Tasmanian market participants should be considered;[104]

- the amount of time that operating constraints may bind should be considered;[105]

- existing opportunities in Tasmania for increasing the volumes of Fast Raise and Lower FCAS capability within Tasmania should be considered;[106]

- balancing the power system security and reliability with the efficient economic operation of the market should be considered;[107]

- consistent application of operational standards across the market, subject to economic and technical feasibility, and agnostic to technology should be considered;[108]

- grandfathering for existing investments should be considered;[109]

- impacts on the local market structure, new entrants, the imposition of costs or restrictions on incumbents, and on competitive outcomes should be considered;[110]

- an outcome where there are frequent or severe constraints on the operation of Basslink or on dispatch, very high costs for FCAS, or an inordinate level of complexity and risk should be avoided;[111] and

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100 Hydro Tasmania submission, 23 May 2008, p. 10; Roaring 40s submission, 23 May 2008, p. 2.

101 Hydro Tasmania submission, 23 May 2008, p. 10.

102 Roaring 40s submission, 23 May 2008, p. 2; Roaring 40s supplementary submission, 1 August 2008, p. 3.

103 Transend submission, 23 May 2008, p. 16.

104 Transend submission, 23 May 2008, p. 16.

105 Transend submission, 23 May 2008, p. 16.

106 Transend submission, 23 May 2008, p. 16.

107 NGF submission, 28 May 2008, p. 1.

108 NGF submission, 28 May 2008, p. 1.

109 NGF submission, 28 May 2008, p. 1.

110 NGF submission, 28 May 2008, p. 2.

111 David Llewellyn MP submission, 21 May 2008, p. 2.

- alternative approaches in order to retain the existing Tasmanian *frequency operating standards* where the proposed plant can comply with the existing Tasmanian *frequency operating standard* should be considered.[112]

C.3 System security

C.3.1 Coordination of UFLSS, OFGSS, and FCSPS

Submissions supported the review of the back-up system protection schemes when considering the proposed changes to the Tasmanian *frequency operating standards*.[113] These schemes include the Under Frequency Load Shedding Scheme (UFLSS), Over Frequency Generator Shedding Scheme (OFGSS) and Frequency Control System Protection Scheme (FCSPS).

Some stakeholder comments related to proposed changes to the UFLSS settings include:

- there should be sufficient discrimination between the various blocks in the proposed new settings;[114]
- the UFLSS cannot operate for all possible contingencies;[115]
- generators should not trip with changes in block size;[116]
- tightening the frequency bands reduces the available time to carry out UFLSS control actions;[117]
- the UFLSS must not operate for Basslink contingency events; [118] and
- the UFLSS must be capable of arresting frequency if the FCSPS fails.[119]

In terms of proposed changes to OFGSS settings, stakeholders made the following comments:

- whether the re-designed OFGSS meets the Rules requirements;[120]
- whether the redesigned OFGSS meets the negotiated access requirements;[121]

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[112] Hydro Tasmania supplementary submission, 1 August 2008, p. 35.
[113] Alinta submission, 24 April 2008, pp. 3-4; Hydro Tasmania submission, 23 May 2008, p. 20.
[114] Alinta submission, 24 April 2008, p. 21.
[115] Hydro Tasmania submission, 7 August 2008, p. 1.
[116] Alinta submission, 24 April 2008, p. 21.
[117] ETAC submission, 28 September 2007, p. 6.
[118] ETAC submission, 28 September 2007, p. 6.
[119] ETAC submission, 28 September 2007, p. 6.
[120] Alinta submission, 24 April 2008, p. 22.

- whether the redesigned OFGSS would create over-tripping of generation, resulting in an under frequency event;[122]

- complex logic and coordinated settings would be required in the redesigned OFGSS to ensure robustness;[123] and

- consideration of congestion and existing opportunities to manage it via established market processes.[124]

Stakeholders discussed the following matters in relation to FCSPS:

- FCAS will need to be increased to meet the proposed *frequency operating standards* if the FCSPS settings remain at the current levels;[125]

- it will need to be verified on whether the current FCSPS maintains the frequency to above the proposed frequency of 48.0 Hz for the loss of Basslink on import;[126]

- whether the current Basslink FCSPS design needs to be redesigned to allow the proposed frequency of 52.0 Hz to be achieved following the loss of Basslink on export;[127]

- whether the UFLSS scheme needs to be designed to ensure that it will not operate for the tripping of Basslink during import conditions and that there is enough discrimination between the Basslink FCSPS and the UFLSS;[128]

- whether the OFGSS will need to be designed to ensure that there is enough discrimination between the Basslink FCSPS and the OFGSS;[129]

- recalculation of required generator tripping for loss of Basslink export would be required;[130]

- recalculation of required load tripping for loss of Basslink import scenario's would be required;[131]

- the terms in commercial agreements allow loads to be made available to the FCSPS and for major loads to be withdrawn from the SPS if they are tripped for an FCSPS event;[132]

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121 Alinta submission, 24 April 2008, p. 22.

122 Hydro Tasmania submission, 23 May 2008, p. 20.

123 Hydro Tasmania submission, 23 May 2008, p. 21.

124 Transend submission, 23 May 2008, p. 7.

125 Alinta submission, 24 April 2008, pp. 22.-23.

126 Alinta submission, 24 April 2008, pp. 22.-23.

127 Transend submission, 23 May 2008, p. 23; Hydro Tasmania submission, 23 May 2008, p. 20.

128 Alinta submission, 24 April 2008, pp. 22.-23.

129 Alinta submission, 24 April 2008, pp. 22.-23.

130 ETAC submission, 28 September 2007, p. 7.

131 ETAC submission, 28 September 2007, p. 8.

- whether there is any impact of future wind developments on overall system response characteristics;[133]

- appropriateness of safety margins in the FCSPS design;[134] and

- whether there is sufficient load and generation currently available to the FCSPS for maximum Basslink transfers under all conditions.[135]

Alinta and Transend made the following findings on the above issues:[136]

- changes to settings for the UFLSS to be shifted upwards by 0.5 Hz in the Tasmanian *frequency operating standards* will be required;

- discrimination between FCSPS and OFGSS exists;

- discrimination between FCSPS and UFLSS $\Delta f/\Delta t$ (average frequency over 300 second period) setting in the UFLSS can be achieved by increasing this to 1.2 Hz;

- the CCGT adds significant FCAS lowering capability and reduces FCSPS generation shedding quantity in many cases if this capability were made available to the FCAS markets;

- over-frequency is a problem under multiple contingencies and the CCGT could trip causing UFLSS to shed load which could breach the proposed Tasmanian *frequency operating standard*;

- CCGT plants and other thermal plants should be included in OFGSS and coordinated to shed generation in a planned manner; and

- to prevent all the CCGT plants and other thermal plants tripping simultaneously and causing severe load shedding, the over frequency issue needs to be resolved.

In submissions to the draft report the following points were raised by Aurora Energy Tamar Valley and Transend in relation to the operation of UFLSS, OFGSS, and FCSPS:

- there is ambiguity in the application of the UFLSS under the new standard, with a similar system that was described for the OFGSS in the standard to prevent non-compliance issues with CCGT;[137]

- in respect of the OFGSS, the upper limit of the operational frequency tolerance band should be lowered to 51.6 Hz rather than the 52 Hz that has been proposed by the Reliability Panel;[138]

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132 ETAC submission, 28 September 2007, p. 8.

133 Transend submission, 23 May 2008, p. 7.

134 Transend submission, 23 May 2008, p. 7.

135 Transend submission, 23 May 2008, p. 8.

136 Alinta submission, 24 April 2008, pp. 3-4; Transend submission, 23 May 2008, pp. 7-9.

137 Aurora Energy Tamar Valley's submission to the draft report, p. 3.

- "…possible to modify the settings of the FCSPS to accommodate the proposed changes to the frequency standards";[139]

- "…possible to modify the settings of the UFLSS to accommodate the proposed changes while maintaining a suitably co-ordinated, robust system to manage non-credible contingencies";[140]

- "…possible to modify the settings of the OFGSS to accommodate the proposed changes to the frequency standards; however, notes that it will not be possible to form viable islands under all dispatch conditions".[141]

In addition, Transend considers that setting the upper limit of the *operational frequency tolerance band* to 52 Hz will require it to develop what is termed the Over Frequency Co-ordination Scheme (OFCS), with the following components:

- "…the OFCS will take account of OFGSS and existing over-speed settings (for generators already connected to the network) and use this as a basis for determining acceptable trip settings for new entrants (likely to request trip settings in the range of 52 to 53 Hz) and will occur as part of the connection agreement".[142]

C.3.2 Sufficient interruptible load available for the UFLSS and any additional requirements

Hydro Tasmania noted one type of source of FCAS supply (although "extremely low" in probability due to the current Rules and market structure) is configuring interruptible loads to provide raise services.[143] It considered that there are a number of loads not required when Basslink is in export or the no-go zone and that "[t]he current market design is unlikely to entice any of these customers into the market".[144]

C.3.3 Sufficient FCAS and other ancillary services available

ETAC noted that there would be insufficient FCAS within Tasmania to manage potential contingency events with Basslink being constrained results in a violation of FCAS constraints. NEMMCO is then required to place constraints on the relevant load or generator.[145]

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138 Gunns submission to the draft report, p. 1.
139 Transend's submission to the draft report, p. 5.
140 Transend's submission to the draft report, p. 5.
141 Transend's submission to the draft report, p. 5.
142 Transend's submission to the draft report, at p. 9.
143 Hydro Tasmania submission, 23 May 2008, p. 4.
144 Hydro Tasmania submission, 23 May 2008, p. 4.
145 ETAC submission, 28 September 2007, p. 11.

ETAC considers that the variables that may affect the setting of the FCAS requirement include Basslink flow, local FCAS availability and system demand that "is an important consideration for all market participants".[146] It suggests that "[a] tightening of the [Tasmanian] frequency [operating] standards would present challenges for the connection of any new generation or load that results in increased FCAS requirements (above those presently seen)".[147] In addition, ETAC considers that "[i]t is also reasonable to assume that increasing the requirement for some FCAS services in a region where local sources of FCAS are limited, will lead to higher prices for those services".[148]

It regards the volume and price of available FCAS are under the control of service providers. With respect to changing the Tasmanian *frequency operating standards*, it proposes that the associated risks of FCAS availability and price need to be taken into account.[149]

The Transend submission discusses issues relating to the availability and procurement of FCAS to support the proposed changes in Tasmanian *frequency operating standard*.[150] It proposes a list of areas that should be considered in terms of cost benefit analysis which is discussed in section C.2 of this Paper.

In submissions to the draft report, stakeholders made the following comments in respect of which party is to pay for the additional FCAS costs incurred as a result of tightening the frequency standards.

- The NGF supports cost recovery mechanisms as outlined in section 4.5 of the draft report, but consider that a Rule change would be a better option, as this would promote certainty for investors;[151]
- Roaring 40s states in its submission that they are "concerned about the permanence of the proposed arrangements given that frequency operating standards are reviewed on a regular basis … where changes in the standards can result in substantive wealth transfers". Changes in the standards may also be "detrimental to dynamic efficiency due to the influence of FCAS price volatility on the decisions around new entrant generation";[152] and
- Hydro Tasmania strongly supports the philosophy of causer pays and supports the first alternative cost recovery mechanism as suggested in the draft report, namely through a Rule change. However, Hydro Tasmania suggests that "any

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146 ETAC submission, 28 September 2007, p. 11.

147 ETAC submission, 28 September 2007, p. 12.

148 ETAC submission, 28 September 2007, p. 12.

149 ETAC submission, 28 September 2007, p. 13.

150 Transend submission, 23 May 2008, pp. 16-17.

151 NGF's submission to the draft report, p. 2.

152 Roaring 40s submission to the draft report, p.2.

implementation of tighter standards be done after determination of any such Rule change proposal".[153]

C.3.4 Fixed contingency limit of 144 MW

Aurora Energy notes that they "have a concern that the proposed requirement of a fixed contingency size of 144 MW will lead to inefficient economic outcomes" and Aurora Energy "believe that a dynamically determined contingency size would provide the maximum economic benefit".[154]

Aurora Energy Tamar Valley notes that "fixing the largest generating contingency is poor because it:

1. does not acknowledge the dynamic nature of the contingency issue;
2. restricts the possibility of market outcomes to the generator contingency limit; and
3. requires a modification of the *frequency operating standards* by the Reliability Panel rather than allowing the limit to be varied as part of the management process of the system".[155]

Furthermore, Aurora Energy Tamar Valley "strongly believe the policy intent of the Reliability Panel is better achieved by giving a formal authority to NEMMCO to formulate a constraint equation to determine maximum dispatchable generation at each trading period for inclusion in the NEMDE dispatch process".[156]

The NGF notes that there "is a very significant benefit for the market in limiting the contingency size, which also puts the cost for management of [the contingency size] with the beneficiary, namely Aurora Energy Tamar Valley".[157] However, the NGF would also welcome "further analysis by the Reliability Panel in establishing whether there is merit on lowering this limit".[158]

Transend is of the opinion that "a variable contingency limit, based on variables such as system inertia, system demand and Basslink power transfer, has technical merit and should be explored".[159] While not feasible within the timeframe of the current review, development work be undertaken to improve the form of the generator

[153] Hydro Tasmania's submission to the draft report, p.9.

[154] Aurora Energy's submission to the draft report, Pp. 1-2.

[155] Aurora Energy Tamar Valley's submission to the draft report, Pp. 1-2.

[156] Ibid. at p.3.

[157] NGF's submission to the draft report, p.2.

[158] Ibid.

[159] Transend's submission to the draft report, p. 7.

contingency size at a later stage. Alternatively, the contingency limit could be expressed in terms of an equivalent FCAS requirement.[160]

Hydro Tasmania also noted that "a 144 MW limit for Tasmania should be included in the frequency standards and is still supportive of such an approach". However, in order to allow time to develop further capacity in the region, a transitory measure be applied to Aurora Energy Tamar Valley that limits the contingency size "equal to the next highest contingency (up to 144 MW) or 115 MW, whichever is the greater".[161]

C.3.5 Other issues associated with a fixed contingency limit

- NEMMCO[162] and Roaring 40s[163] noted that even if the contingency size is limited to 144 MW, there should be wording in the definition that states the time in which tripping of the unit should occur to avoid additional excess FCAS cost requirements;
- Roaring 40s suggested that there could be an issue with the "fixed contingency limit and remote generation that is connected to the network via a long single-circuit transmission line";[164]
- Transend noted there could be an issue in respect of the "application of a 144 MW limit for different contingency types that apply to network events which disconnect generation";[165] and
- Transend also noted that the focus of the draft report "has very much been on the loss of generation and resulting raise FCAS requirements".[166] It suggested that it would be appropriate to give consideration to a maximum contingency size for loss of network load, and should be considered as an issue for a future review.

C.3.6 Other issues raised in submissions

NGF[167] and Hydro Tasmania[168] noted in their submissions that the analysis done by CRA does not appear to be very rigorous with the assumptions implied, but neither proved nor disproved.

Transend noted that the definitions of "generation" and "network events" are more precisely defined. For Generation, the definition should pertain to a *single generating*

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160 Transend's submission to the draft report, p. 7.

161 Hydro Tasmania's submission to the draft report, pp. 5-9

162 NEMMCO's Addendum to advice given to the Reliability Panel, p. 1.

163 Roaring 40s submission to the draft report, p. 1.

164 Roaring 40s submission to the draft report, at pp. 1-2.

165 Transend's submission to the draft report, p. 8.

166 Transend's submission to the draft report, at p. 10.

167 NGF's submission to the draft report, pp. 1-2.

168 Hydro Tasmania's submission to the draft report, pp. 2-4.

system, rather than a *single generating unit* as was defined in the draft report. Similarly, Transend considered that the definition of a network event "should explicitly exclude load events so that a separate load event definition is still applicable".[169]

C.4 Impact of drought

There were two stakeholders that considered the impact of drought.

In Aurora's submission, it noted that "Tasmania is predominately supplied by hydro generation, which is currently at record low water storage levels due to current drought conditions".[170] It considered that the "barriers to entry for new generation" should be avoided "to ensure that the supply/demand balance".[171]

Hydro Tasmania considered that changing to Alinta's proposed Tasmanian *frequency operating standards* would increase the FCAS raise requirements to maintain system security and slightly decrease existing FCAS supplies. It suggested that the combination of these two events would decrease average Basslink imports in order to satisfy system constraints, resulting in "reduce[d] competition in the Tasmanian market by limiting access for mainland generators and could cause supply problems under the current drought conditions". [172]

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169 Transend's submission to the draft report, p. 10.

170 Aurora Energy submission, 23 May 2008, p. 1.

171 Aurora Energy submission, 23 May 2008, p. 1.

172 Hydro Tasmania submission, 23 May 2008, p. 5.